Conference Program

Digest

The 12th International Conference on Manipulation, Manufacturing and Measurement on the Nanoscale

IEEE 3M-NANO 2023

Chengdu, China
31 July - 4 August 2023
Organized by

Sichuan University, China

International Research Centre for Nano Handling and Manufacturing of China

Changchun University of Science and Technology, China

Aarhus University, Denmark

University of Warwick, UK

University of Bedfordshire, UK

Zhongshan Institute of Changchun University of Science and Technology, China

Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing, China

Zhongshan Overseas Students Pioneer Park of China (ZOS-Park)

Sponsored by

IEEE Nanotechnology Council

National Natural Science Foundation of China

Ministry of Science and Technology of the People's Republic of China

Ministry of Education of the People’s Republic of China

Research Executive Agency (REA), European Commission

Jilin Provincial Science & Technology Department

International Society for Nano Manipulation, Manufacturing and Measurement

Sichuan University
International Research Centre for Nano Handling and Manufacturing of China
Changchun University of Science and Technology, China
Aarhus University, Denmark
University of Warwick, UK
University of Bedfordshire, UK
Zhongshan Institute of Changchun University of Science and Technology, China
Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing, China
Zhongshan Overseas Students Pioneer Park of China (ZOS-Park)
Micromachines, An Open Access Journal by MDPI
Nanomaterials, An Open Access Journal by MDPI
International Journal of Extreme Manufacturing (IJEM)
Material Today Bio-Advanced Materials for Disease Diagnosis
Applied Sciences, An Open Access Journal by MDPI
Multidisciplinary Digital Publishing Institute (MDPI)
Anhui Beiyike Equipment Technology
Shanghai Huotong Experimental Instrument
Shanghai Zhanyue Electronic Technology
Greetings

On behalf of the organizing committee, it is our great pleasure and honor to welcome you in Chengdu at IEEE 3M-NANO 2023 conference!

3M-NANO is the annual International Conference on Manipulation, Manufacturing and Measurement on the Nanoscale. It will be held on 31 July - 4 August 2023 in Chengdu, China. The ultimate ambition of this conference series is to bridge the gap between nanosciences and engineering sciences, aiming at technology opportunities and new markets. The advanced technologies for manipulation, manufacturing and measurement at nanoscale promise novel revolutionary products and methods in numerous areas of application. Scientists working in research fields related to 3M-NANO topics are invited to submit papers. All accepted full papers (presented at the conference and following IEEE format) will be submitted in IEEE Xplore database and Ei Compendex. Selected papers will be recommended for publication in the IEEE Trans. on Automation Science & Engineering, Int. J of Nanomanufacturing, IFAC Mechatronics, Int. J of Optomechatronics, J of Micro-Bio Robotics, Journal of Bionic Engineering, Light (Science & Applications), Optics and Precision Engineering and other SCI/EI journals.

Yanrong Li  
IEEE 3M-NANO 2023  
Honorary Chair

Bill Milne  
IEEE 3M-NANO 2023  
Honorary Chair

Zegao Wang  
IEEE 3M-NANO 2023  
General Chair
A major goal of the IEEE 3M-NANO conference is to support a sustainable development of the nanohandling research community and to encourage long-term partnerships and collaborative research activities. To underline this dedication and to provide a get-together forum for all the participants, IEEE 3M-NANO 2023 has organized several exciting social events during and after the conference.

We would like to express our most sincere appreciation to all of our sponsoring organizations and all the individuals who have contributed to this conference. Our special thanks go to our colleagues in various conference committees and the volunteers who worked very hard to ensure the success of IEEE 3M-NANO 2023. Last but definitely not least, we thank all the conference participants for their support and contribution. We do hope that IEEE 3M-NANO 2023 will be the next successful step in this series of annual conferences and give home to rapidly growing nanohandling research community.

We wish you a successful conference and enjoyable stay in Chengdu!
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IEEE 3M-NANO 2023 Committees

Advisory Committee

Chunli Bai       CAS, CN
Karl Böhringer   University of Washington, US
Peter Bryanston-Cross University of Warwick, UK
Nicolas Chaillet FEMTO-ST, FR
Shuo Hung Chang  National Taiwan University, TW
Hyungsuck Cho    KAIST, KR
Harald Fuchs     University of Muenster, DE
Toshio Fukuda    Nagoya University, JP
Shuxiang Guo     Kagawa University, JP
Jianguo Han      NSFC, CN
Huilin Jiang     CUST, CN
Sukhan Lee       Sungkyunkwan University, KR
Tongbao Li       Tongji University, CN
Wen-Jung Li      City University of Hong Kong, HK
Song-Hao Liu     South China Normal University, CN
Bingheng Lu      Xi'an Jiaotong University, CN
Bill Milne       University of Cambridge, UK
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Guoquan Shi      CUST, CN
Zhongqun Tian    Xiamen University, CN
Din Ping Tsai    National Taiwan University, TW
Jia-Qi Wang      CIOMP, CAS, CN
Yuelin Wang      SIMIT, CAS, CN
Ning Xi          Michigan State University, US
Dong-Yol Yang    KAIST, KR
# Organizing Committee

## Honorary Chairs

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yanrong Li</td>
<td>Northwestern Polytechnical University, China</td>
</tr>
<tr>
<td>Bill Milne</td>
<td>University of Cambridge, United Kingdom</td>
</tr>
</tbody>
</table>

## General Chair

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
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<tbody>
<tr>
<td>Zegao Wang</td>
<td>Sichuan University, China</td>
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## Founding Chairs

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
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<tbody>
<tr>
<td>Huadong Yu</td>
<td>Jilin University, China</td>
</tr>
<tr>
<td>Sergej Fatikow</td>
<td>University of Oldenburg, Germany</td>
</tr>
<tr>
<td>Zuobin Wang</td>
<td>Changchun University of Science and Technology, China</td>
</tr>
</tbody>
</table>

## Local Committee Chairs

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ying Liu</td>
<td>Sichuan University, China</td>
</tr>
<tr>
<td>Jiagang Wu</td>
<td>Sichuan University, China</td>
</tr>
</tbody>
</table>

## Program Chairs

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
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<tbody>
<tr>
<td>Mingdong Dong</td>
<td>Aarhus University, Denmark</td>
</tr>
<tr>
<td>He Tian</td>
<td>Tsinghua University, China</td>
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## Publication Chairs

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<tr>
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<tr>
<td>Yanling Tian</td>
<td>University of Warwick, United Kingdom</td>
</tr>
<tr>
<td>Zhankun Weng</td>
<td>Changchun University of Science and Technology, China</td>
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<tr>
<td>Jinkai Xu</td>
<td>Changchun University of Science and Technology, China</td>
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# Conference Secretariat

<table>
<thead>
<tr>
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<th>Institution</th>
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<tbody>
<tr>
<td>Wenjun Li</td>
<td>Changchun University of Science and Technology, China</td>
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<tr>
<td>Yingying Song</td>
<td>Changchun University of Science and Technology, China</td>
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<tr>
<td>Dongxu Wang</td>
<td>Changchun University of Science and Technology, China</td>
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</tbody>
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# Web Master

<table>
<thead>
<tr>
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<th>Institution</th>
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<tbody>
<tr>
<td>Binbin Cai</td>
<td>Changchun University of Science and Technology, China</td>
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# 3M-NANO logo design

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<th>Name</th>
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<tbody>
<tr>
<td>cm-logic</td>
<td>Changchun University of Science and Technology, China</td>
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</table>
Program Committee

Nitin Afzulpurkar (TH)  Tomohiro Kawahara (JP)  Mariaana Savia (FI)
Gursel Alici (AU)  Beomjoom Kim (JP)  Minoru Seki (JP)
Wei Tech Ang (SG)  Viktor Koledov (RU)  Yajing Shen (HK)
Fumihiro Arai (JP)  Kostadin Kostadinov (BG)  Wen-Pin Shih (TW)
Karl Böhringer (US)  Wai Chiu King Lai (HK)  Bijan Shirinzadeh (AU)
Aude Bolopion (FR)  Pierre Lambert (BE)  Albert Sill (DE)
Barthelemy Cagneau (FR)  Richard Leach (UK)  Metin Sitti (US)
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Yunfei Chen (CN)  Yangmin Li (MO)  Daoheng Sun (CN)
Yu-Bin Chen (TW)  Liwei Lin (US)  Dong Sun (HK)
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Ruxu Du (HK)  Michael Molinari (FR)  Weidong Wang (CN)
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Vladimir Falco (UK)  Cun-Zheng Ning (US)  Zhipeng Wei (CN)
Fengzhou Fang (CN)  Cagdas Onal (US)  Zhankun Weng (CN)
Antoine Ferreira (FR)  Inkyu Park (KR)  Wenming Xi (CN)
Michaël Gauthier (FR)  Babak Parviz (US)  Hui Xie (CN)
L. Jay Guo (US)  Changsi Peng (CN)  Hongmei Xu (CN)
Shuxiang Guo (JP)  Xiaogang Peng (CN)  Yoko Yamanishi (JP)
Sinan Haliyo (FR)  Yves-Alain Peter (CA)  Yuen Kuan Yong (AU)
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<tr>
<td>Tawfique Hasan</td>
<td>UK</td>
<td>Wilhelm Pfleging</td>
<td>DE</td>
<td>Yong Yue</td>
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<tr>
<td>Martin Hoffmann</td>
<td>DE</td>
<td>Valentin Popov</td>
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<td>Alice Zhang</td>
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<td>Manel Puig-Vidal</td>
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<td>Wenhao Huang</td>
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<td>Linmao Qian</td>
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<td>Qing Zhang</td>
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<td>Futoshi Iwata</td>
<td>JP</td>
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<td>Xianmin Zhang</td>
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<td>Baohua Jia</td>
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<td>Yoshiaki Kanamori</td>
<td>JP</td>
<td>Weibin Rong</td>
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<td>Quan Zhou</td>
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<tr>
<td>Jayantha Katupitiya</td>
<td>AU</td>
<td>Shanghai Ru</td>
<td>CN</td>
<td>Hanxing Zhu</td>
<td>UK</td>
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</tbody>
</table>
Conference Information

Venue and Accommodation

Venue

Chengdu Homeland Hotel is a five-star garden hotel integrating business and leisure and also one of the hotels with villas in China. The hotel covers an area of over 400 acres, with extensive greenery where the ecological beauty of nature could be enjoyed.

It is located at the intersection of Chengdu Airport Expressway and Shunfeng Road, which is 6 kilometers away from the Shuangliu International Airport. It offers superior geographical location and convenient transportation conditions, and occupies convenient transportation routes such as the Airport Expressway, the Third Beltway Road, and the Beltway Expressway.

The main building of the hotel has elegant guest rooms and suites, as well as 37 villas meticulously designed by renowned Chinese and foreign experts in different styles.

Address: 181 Jichang Road, Chengdu, Sichuan, China
Tel: +86 28 82936666
Fax: +86 28 82936668

Accommodation

The accommodation of IEEE 3M-NANO 2023 is arranged in the Chengdu Homeland Hotel.
How to get to Chengdu Homeland International Hotel (IEEE 3M-NANO 2023 Venue)

1. From Chengdu Shuangliu International Airport (6 km to Homeland Hotel)

   Plan A: Public transport (Lines 10-9-8): From Chengdu Shuangliu International Airport Terminal 2 Station, take Line 10 (Taipingyuan direction), 3 stops to Huaxing Station, transfer to Line 9 (Financial City Oriental), 2 stops to Sanyuan Station, transfer to Line 8 (Lotus direction), 1 stop to Shunfeng Station (Exit B), walk 252 meters to the hotel (About 33 minutes, 4 Yuan).


2. Tianfu International Airport (68 km to Homeland Hotel)

   Plan A: Public transport (Lines 18-9-8): From Tianfu Airport Terminal 1 and Terminal 2 Station, take Line 18 (towards South Railway Station), 7 stops to Incubation Park Station, transfer to Line 9 (Huangtianba direction), 2 stops to Sanyuan Station, transfer to Line 8 (Lotus direction), 1 stop to Shunfeng Station (Exit B), walk 252 meters to the hotel (About 70 minutes, 10 Yuan).

   Plan B: Taxi: about 80 minutes, 120-150 Yuan.

3. From Chengdu East Railway Station (16 km to Homeland Hotel)

   Plan A: Public transport (Lines 2-8): From Chengdu East Railway Station, take Line 2 (Xipu direction), 2 stops to Dongda Road Station, transfer to Line 8 (Lotus direction), 14 stops to reach Shunfeng Station (Exit B), walk 252 meters to the hotel (About 43 minutes, 5 Yuan).

   Plan B: Taxi: about 50 minutes, 37-55 Yuan.
4. From Chengdu West Railway Station (14 km to Homeland Hotel)

   Plan A: Public transport (Lines 9-8): From Chengdu West Railway Station, take Line 9 (Financial City Oriental), 7 stops to Sanyuan Station, transfer to Line 8 (Lotus direction), 1 stop to Shunfeng Station (Exit B), walk 252 meters to reach the hotel. (About 38 minutes, 5 Yuan).

   Plan B: Taxi: about 55 minutes, 38-55 Yuan.

5. From Chengdu South Railway Station (7.2 km to Homeland Hotel)

   Plan A: Public transport (Lines 7-8): From South Railway Station, take the inner ring of Line 7 (Shenxianshu direction), 2 stops to Gaopeng Avenue Station, transfer to Line 8 (Lotus direction), 5 stops to Shunfeng Station (Exit B), walk 252 meters to the hotel (About 32 minutes, 4 Yuan).

   Plan B: Public transport (Lines 1-8): From South Railway Station, take Line 1 (Weijiayuan direction), 2 stops to Nijiaqiao Station, transfer to Line 8 (Lotus direction), 9 stops to Shunfeng Station (Exit B), walk 252 meters to the hotel. (About 33 minutes, 4 Yuan).

   Plan C: Taxi: about 35 minutes, 20-25 Yuan.
Floor Map of Conference Rooms

Conference registration will be arranged on the following days:

31 July, Chengdu Homeland Hotel Lobby, 1F
1-3 August, Chengdu Homeland Hotel Conference Hall, 2F
# IEEE 3M-NANO 2023

## Program at a Glance

### Monday, 31 July, 13:00-18:00

**Chengdu Homeland Hotel, Lobby, 1F**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:00—08:20</td>
<td>Registration</td>
</tr>
</tbody>
</table>

### Tuesday, 1 August, 8:00-18:30, Conference Hall, 2F

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
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<tbody>
<tr>
<td>08:00—08:20</td>
<td>Opening ceremony</td>
</tr>
<tr>
<td>08:20—10:20</td>
<td>Keynote reports (4)</td>
</tr>
<tr>
<td>10:20—10:40</td>
<td>Break</td>
</tr>
<tr>
<td>10:40—12:40</td>
<td>Keynote reports (4)</td>
</tr>
<tr>
<td>12:40—14:00</td>
<td>Lunch</td>
</tr>
<tr>
<td>14:00—16:00</td>
<td>Keynote reports (4)</td>
</tr>
<tr>
<td>16:00—16:20</td>
<td>Break</td>
</tr>
<tr>
<td>16:20—18:30</td>
<td>Keynote reports (5)</td>
</tr>
<tr>
<td>18:30—20:00</td>
<td>Welcome banquet</td>
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</table>

### Wednesday, 2 August, 8:00-12:20, Rooms 1-7, 2F

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>08:00—10:00</td>
<td>Parallel technical sessions</td>
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<tr>
<td>10:00—10:20</td>
<td>Break</td>
</tr>
<tr>
<td>10:20—12:20</td>
<td>Parallel technical sessions</td>
</tr>
<tr>
<td>12:20—14:00</td>
<td>Lunch</td>
</tr>
<tr>
<td>Time</td>
<td>Event</td>
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<tr>
<td>Wednesday, 2 August, 14:00-18:20, Rooms 1-8, 2F</td>
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<tr>
<td>14:00—16:00</td>
<td>Parallel technical sessions</td>
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<tr>
<td>16:00—16:20</td>
<td>Break</td>
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<tr>
<td>16:20—18:20</td>
<td>Parallel technical sessions</td>
</tr>
<tr>
<td>18:20—20:00</td>
<td>Conference dinner</td>
</tr>
<tr>
<td>Thursday, 3 August, 08:00-12:20, Rooms 1-7, 2F</td>
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<tr>
<td>08:00—10:00</td>
<td>Parallel technical sessions</td>
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<td>10:00—10:20</td>
<td>Break</td>
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<tr>
<td>10:20—12:20</td>
<td>Parallel technical sessions</td>
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<tr>
<td>12:20—14:00</td>
<td>Lunch</td>
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<tr>
<td>Thursday, 3 August, 14:00-18:20, Conference Hall, 2F</td>
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<tr>
<td>14:00—16:00</td>
<td>Keynote reports (4)</td>
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<td>16:00—16:20</td>
<td>Break</td>
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<td>16:20—18:20</td>
<td>Keynote reports (4)</td>
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<td>18:20—19:00</td>
<td>Closing ceremony</td>
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<tr>
<td>19:00—21:00</td>
<td>Farewell banquet</td>
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<td>Friday, 4 August</td>
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<td>Social Culture Activities</td>
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# Schedule of the Keynote Reports

**Tuesday, 1 August, Conference Hall, 2F**

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:20 – 08:50</td>
<td>Development of a Commercial Inspecting Tool for Detecting nm-size Phase Defects on a Multilayer EUV Mask Blank</td>
<td>Toshihisa Tomie (Japan)</td>
</tr>
<tr>
<td>08:50 – 09:20</td>
<td>Towards CMOS/2D Hybrid Microchips</td>
<td>Mario Lanza (Saudi Arabia)</td>
</tr>
<tr>
<td>09:20 – 09:50</td>
<td>Low-dimensional Semiconductor Materials for Stretchable Electronics and Tactile Sensing</td>
<td>Caofeng Pan</td>
</tr>
<tr>
<td>09:50 – 10:20</td>
<td>The Importance of Nano-scale Omics in Attaining the UN Sustainable Development Goals</td>
<td>Michael James Cardwell Crabbe (UK)</td>
</tr>
<tr>
<td>10:40 – 11:10</td>
<td>Controlled Materials Engineering via Microfluidic Technologies</td>
<td>Josep Puigmartí Luis (Spain)</td>
</tr>
<tr>
<td>11:10 – 11:40</td>
<td>Phospholipid Assembly Based Artificial Cells</td>
<td>Xiaojun Han</td>
</tr>
</tbody>
</table>
### Tuesday, 1 August 2023, Conference Hall, 2F

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:10 – 12:40</td>
<td>Funding Opportunities for Individual Researchers under Horizon Europe</td>
<td>Anna Facchinetti (Italy)</td>
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#### Session Chair: Jie Song

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>14:00 – 14:30</td>
<td>Highly Functional Magnetic Miniature Robots</td>
<td>Guo Zhan Lum (Singapore)</td>
</tr>
<tr>
<td>14:30 – 15:00</td>
<td>Nano-Micro Materials Science and Engineering for Optofluidics</td>
<td>Zhiming Wang</td>
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</tbody>
</table>

#### Session Chair: Yufeng Zhou

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
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</thead>
<tbody>
<tr>
<td>15:00 – 15:30</td>
<td>Development of Lubricated Biomaterials for Various Biomedical Applications</td>
<td>Hongyu Zhang</td>
</tr>
<tr>
<td>15:30 – 16:00</td>
<td>Characterisation of Hydrogen in Nanoporous Hydrogen Storage Materials via Neutron Scattering</td>
<td>Valeska Ting (UK)</td>
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</table>

#### Session Chair: Mingdong Dong

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
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<tr>
<td>16:20 – 16:40</td>
<td>Super-resolution Scanning ion conductive microscopy for Quantitative measurements</td>
<td>Mingdong Dong</td>
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<tr>
<td>16:40 – 17:00</td>
<td>Publishing in Wiley Material Science &amp; Physics Journals - How to Maximize Your Success</td>
<td>Huan Wang</td>
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### Thursday, 3 August 2023, Conference Hall, 2F

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<td>17:00 – 17:30</td>
<td>Dynamic Structural Biology Driven by High-Speed Atomic Force Microscopy</td>
<td>Takayuki Uchihashi (Japan)</td>
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**Session Chair: Deyang Ji**

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<td>High-Frequency Nanoelectromechanical Interactions Between Sound and Matter: A New Method for the Synthesis, Processing and Manipulation of Two-Dimensional and Bulk Crystals</td>
<td>Leslie Yeo (Australia)</td>
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<td>14:00 – 14:30</td>
<td>Micro-/NanoRobotic Systems: Physical Integration and Applications</td>
<td>Lixin Dong</td>
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<td>14:30 – 15:00</td>
<td>Surface Nano-Structuring of Semiconductors by Nanosecond Pulsed Laser Interference</td>
<td>Mark Hopkinson (UK)</td>
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**Session Chair: Yuda Zhao**

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<tr>
<td>15:00 – 15:30</td>
<td>Nanoscale Metrology and Its Enabling Role in Advanced Manufacturing</td>
<td>Chanmin Su</td>
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<tr>
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<td>Quantum Regimes of Coherent X-ray Generation with Strongly Correlated Electron Dynamics and Attosecond Rabi Oscillations for Advanced Nanoimaging</td>
<td>Tenio Popmintchev (USA)</td>
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<td>16:20 – 16:50</td>
<td>Engineered Living and Dead Materials: From 3D Printable Enzyme Plastics to Living Bacterial Microreactors</td>
<td>Adam Willis Perriman</td>
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<td>16:50 – 17:20</td>
<td>Polarization-Sensitive Photodetector and Image Sensor Based on 2D Materials</td>
<td>Zhongming Wei</td>
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<td>17:20 – 17:50</td>
<td>Multifunctional Materials for Emerging Technologies</td>
<td>Federico Rosei (Canada)</td>
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<td>17:50 – 18:20</td>
<td>COVID-19 Vaccines Induce Protective Immunity Against Omicron Variant</td>
<td>Yuquan Wei</td>
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Invited Speakers
(in alphabetical order)

EU Funding for Individual Researchers Under Horizon Europe Framework Programme

Anna Facchinetti
Sant’ Anna School of Advanced Studies.
China Research and Project Coordinator at the University of Bergamo
Country Representative at EURAXESS China
Italy

Abstract: Horizon Europe is the ambitious EU research & innovation framework programme for 2021-2027 with a budget of €95.5 billion. It offers multiple funding opportunities to individual researchers of any nationality in different fields of science and at various career stages.

Horizon Europe’s Pillar I focuses on Excellent Science and is aimed at reinforcing and extending the excellence of the Union's science base. Under Pillar I, the European Research Council offers individual researchers with groundbreaking ideas different grant schemes of up to 2.5€ million, open to a wide audience, from promising early-career researchers to established research leaders.

The Marie Skłodowska-Curie Actions (MSCA) also contribute to foster excellence in researcher by offering illustrious opportunities. The MSCA Postdoctoral Fellowships action targets researchers holding a PhD who wish to carry out their research activities abroad, acquire new skills and develop their careers and are considered the most prestigious research fellowships in Europe.
Publishing with Nature Journals

Bo Liu
Executive Editor for Nature Partner Journals
scientific editor Nature Communications
Springer Nature

Abstract: In this talk, I will introduce the Nature family journals, their editorial process, how to prepare a manuscript for a top journal from an editor’s perspective.

Bio: Bo Liu is the Executive Editor for 10 Nature Partner Journals (npjs) spanning in a broad range of physical, environmental and social science subject areas. Bo joined Springer Nature as a scientific editor at Nature Communications in 2017, where he spent three years handling manuscripts on solar cells and semiconductor photo-physics. Prior to his editorial career, Bo graduated from Zhejiang University, China, and obtained a PhD in Physics at National University of Singapore. He also worked as a postdoc at the Graphene Research Center in Singapore and University of Washington, US. Bo is now based in Shanghai.
Publishing in Wiley Material Science & Physics Journals - How to Maximize Your Success

Huan Wang

Editor-in-Chief of Advanced Quantum Technologies
Editor Advanced Functional Materials
Editor Advanced Intelligent Systems
John Wiley & Sons

Abstract: To maximize academic authors’ success in publishing, the speaker Huan Wang will share her advice on how to structure a paper, write a cover letter, and deal with awkward feedback from reviewers. An introduction of Wiley Online Library, the entire peer-review process, the materials science and physics journals in Wiley (Advanced Intelligent Systems, Advanced Functional Materials, Advanced Quantum Technologies, etc.), duplication-checking and the plagiarism guidelines will be delivered to the attendees as well.
The Insertion of Putative Aminosterol Drugs Against Neurodegenerative Diseases. From the Characterization at The Nanoscale Level to its Mechanism of Action in Cells and Clinical Trials

Fabrizio Chiti

Academician
Professor of Biochemistry at the University of Florence
Member of the scientific board of the Doctorate/PhD Program in Biomedical Sciences, Coordinator
The Academy of Europe
Italy

Abstract: Natural aminosterols, such as squalamine and trodusquemine, are promising drug candidates against neurodegenerative diseases, like Alzheimer and Parkinson diseases. They are known to inhibit membrane-induced protein aggregation and prevent the binding of misfolded protein oligomers to cell membranes, therefore reducing toxicity in a wide range of neurodegenerative diseases, such as Alzheimer and Parkinson diseases. One of these small molecules has just ended a phase II clinical trial for the treatment of Parkinson diseases and associated constipation. Using a number of experimental techniques at the nanoscale level, we elucidated the mechanism of insertion of trodusquemine into the lipid bilayer of large unilamellar vesicles (LUVs). The displayed binding behaviour causes three major physicochemical changes of the lipid bilayer, all known to impair the interaction of misfolded protein oligomers with the cell membrane, protecting it from their toxicity. We then compared three chemically different aminosterols, finding that they affected each of these membrane properties to different extents and also had different potencies (EC50) in protecting cultured cell membranes against amyloid-β oligomers associated with Alzheimer disease. A global fitting analysis led to an analytical equation describing quantitatively the protective effects of aminosterols as a function of their concentration and relevant membrane effects (validated by the leave-one-out cross-validation method), as well as chemical moieties. The analysis correlates aminosterol-mediated protection with well-defined chemical moieties, linking quantitatively their chemistry to their protective effects on biological membranes.
The Importance of Nano-Scale Omics in Attaining the UN Sustainable Development Goals

Michael James Cardwell Crabbe
Emeritus Professor
 Supernumerary Fellow, Wolfson College
 President, International Engineering and Technology Institute (IETI)
University of Oxford
UK

Abstract: The 17 Sustainable Development Goals (SDGs) are an urgent call for action by all countries-developed and developing-in a global partnership. They recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth-all while tackling climate change and working to preserve our oceans and forests. Omics techniques at the nano-scale-genomics, epigenomics, transcriptomics, metabolomics, proteomics - are critical in attaining the SDGs. Examples of their application in medicine, environmental issues on land and in the ocean, plant evolution and public health will be given. Education about these issues at all levels of the population will be vital for policy development in the future.
**Micro-/Nanorobotic Systems: Physical Integration and Applications**

**Lixin Dong**

Professor  
Department of Biomedical Engineering  
Vice President for Educational Activities, IEEE Nanotechnology Council  
City University of Hong Kong  
China

**Abstract:** One of the common challenges for microrobots, neuro dust, smart dust and other micro-sized systems is their functionalization while keeping a miniaturized size. For microrobots, tremendous attention has been paid to locomotion, navigation, chemical functionalization for biocompatibility, and various designs for cargo carrying. However, most micro-sized robots still look like specially shaped particles or colloids while the others are still big in size. On the other hand, the advancement of low dimensional nanomaterials has provided possibilities to tackle the barrier in integrating these carriers with such devices as wireless energy/signal transmitters, sensors, actuators, and tools built from them. This talk briefly reviews the recent advancement of nanorobotic manipulation for in-situ prototyping of nanodevices based on transmission electron microscopy (TEM), scanning TEM (STEM), and scanning electron microscopy (SEM), and highlights recent trends in embedding structural and collective intelligence into microrobotic systems. Essential techniques for rapid prototyping and device-level structure-property correlation are demonstrated using nanorobotic manipulation and a variety of stimuli and chips for in-situ nanorobotic technologies, which enable rapid prototyping of nanodevices, provide boundary conditions for nanodevice simulation, assist in determining structural parameters for their design and optimization, and serve for the quality control of batch-fabricated systems.
Super-resolution Scanning ion Conductive Microscopy for Quantitative measurements

Mingdong Dong
Professor
Interdisciplinary Nanoscience Center at Aarhus University Denmark
Aarhus University
China

Bio: Mingdong Dong is Professor in the Interdisciplinary Nanoscience Center at Aarhus University Denmark. He is applied physicist specializing in advanced surface sensitive scanning probe microscopy (SPM). He has developed several important quantitative SPM-based surface sensitive techniques to investigate electronic, mechanical, thermal, chemical, and magnetic properties in biological systems and nanomaterials, which have been critically important for a better understanding of structure-function relationship. His academic experience ranges from materials science, physical chemistry to biophysics, covers problems in life science and nanoscience, encompasses expertise in SPM. He has published more than 300 papers (More than 16000 citations, H-index of 65) in top international peer reviewed journals such as Nature, Nature Nanotechnology, Nature Chemistry, Nature Communications, PNAS, Angewandte Chemie, Nano Letters, JACS, ACS NANO, Advanced Materials, etc. Dr. Dong has been a member of Royal Microscopical Society, ACS, MRS, Biophysical Society and Fellow of the Royal Society of Chemistry.
**Phospholipid Assembly Based Artificial Cells**

**Xiaojun Han**

Professor  
Head of Chemistry Department  
School of Chemistry and Chemical Engineering  
Harbin Institute of Technology  
China

**Abstract:** Life begins with cells. Artificial cells are cellular like structures that can mimic some (or all) of cell functions. Building artificial cells from the bottom up helps to reveal the working mechanism of cells and provide a theoretical basis for the origin of life. Because phospholipid molecules themselves are the components of cell membranes, they have inherited advantages in constructing artificial cells. Targeting the key issues in this field, we carried out following projects in recent years [1]. We constructed giant unilamellar vesicles (GUVs) in physiological salt solutions, which laid the foundation for the construction of complex artificial cells. Based on this achievement, the mechanism of the influence of osmotic pressure on vesicular deformation was further clarified to construct a divisible artificial "eukaryotic cell" [2]. The chemical information exchange between two "organelles" within the artificial cell was also realized. We developed a method to construct non spherical organelles [3,4] to mimic chloroplast grana capable of capturing light energy. We built spatial coded artificial tissues using magnetic and acoustic fields. These tissues possessed the vasodilation and muscle contraction functions [5-7].

**References:**


Surface Nano-Structuring of Semiconductors by Nanosecond Pulsed Laser Interference

Mark Hopkinson
Professor
Department of Electronic & Electrical Engineering
The University of Sheffield
UK

Abstract: In this work, we present an innovative approach for nano-structuring semiconductor surfaces using an in-situ patterning process. Nanosecond pulsed direct laser interference patterning (DLIP) combined with epitaxial growth is introduced to create functional surface features on semiconductors in a rapid single-exposure step. By utilising two to four laser beams, submicron periodic nanostructures including 1D nano-gratings, 2D nano-islands and nano-holes are fabricated, serving as nucleation centres for the formation of quantum dots. The ability to create periodic features offers control over the spatial arrangement and properties of the resulting quantum structures. This direct and efficient nature of the technique makes it promising for practical applications in various fields, such as optoelectronics, nanophotonics and quantum technologies.
Towards CMOS/2D Hybrid Microchips

Mario Lanza

Associate Professor
Physical Science and Engineering Division
Chair of the Nanotechnology Committee of the Electron Devices Society
King Abdullah University of Science and Technology (KAUST)
Saudi Arabia

Abstract: Two-dimensional layered materials (2D-LMs) materials have outstanding physical, chemical and thermal properties that make them attractive for the fabrication of solid-state micro/nano-electronic devices and circuits. However, synthesizing high-quality 2D-LMs at the wafer scale is difficult, and integrating them in semiconductor production lines brings associated multiple challenges. Nevertheless, in the past few years substantial progress has been achieved and leading companies like TSMC, Samsung and IMEC have started to work more intensively on the fabrication of devices using 2D-LMs. In this keynote talk, I will discuss the state-of-the-art on micro/nano-electronic devices made (entirely or partially) of 2D-LMs, the most sophisticated circuits ever constructed, and the fabrication of CMOS/2D hybrid microchips. I will put special emphasis on devices that employ hexagonal boron nitride, the only 2D-LM with an enough high band gap to be employed as dielectric. I will also discuss the main technological challenges to face in the next years and provide some recommendations on how to solve them.
Single-Molecule Electrical Characterization on a Controllable-Break-Junction Chip Through Electrostatic Microactuators

Junyang Liu

Associate Professor
College of Chemistry and Chemical Engineering
Innovation Laboratory for Sci. & Tech. of Energy Materials of Fujian Province (iKEM)
Xiamen University
China

Abstract: Micro/nano-manufacturing technology has greatly promoted the development of molecular electronics, with the success rate and stability of molecular junction fabrication being greatly improved, which makes molecular electronic devices with complex structures and circuits possible. We aim to develop a series of microchips that can be used for optical, electrical, and thermal measurement experiments at the single-molecule scale, based on our previously established precise micro/nano-manufacturing technologies with high-energy electron and ion beams in a noise-free laboratory environment.

At present, our group has developed a mechanically controlled break junction (MCBJ) technology on a microchip with high stability for the electrical characterization of molecular junction structure and chemical reactions at a single-molecule scale. However, this chip still needs an additional drive motor to control the opening and closing of the nanoelectrodes, which brings inconvenience to achieving controllable preparation and integration of molecular electronic devices.

To further promote the miniaturization and integration of single-molecule electronics, we develop an on-chip break junction system, which uses electrostatic actuation of MEMS to replace the complex external motor to accurately drive the nanoelectrodes for nanogap creation to match the length of a target molecule, so as to construct and manipulate the single-molecule junction. This break-junction chip enables more stable and controllable molecular junction construction, and allows for the simultaneous fabrication of multiple molecular devices on a single chip. This will provide new ideas and methods for the preparation and application of molecular devices.

References:


**Controlled Materials Engineering via Microfluidic Technologies**

Josep Puigmartí Luis

Professor
Department of Materials Science and Physical Chemistry
Institute of Theoretical and Computational Chemistry
University of Barcelona
Spain

**Abstract:** Self-assembly has long being used to control covalent and non-covalent interactions where molecular design has been the major driving force to achieve a desired outcome. Like in nature, a full control over self-assembly processes could lead to rationalized structure-property correlations, a long-time sought in chemistry, physics and materials science. However, the pathways followed and the mechanisms underlying the formation of supramolecular aggregates are still a major challenge for the scientific community. Accordingly, the elucidation of nucleation and growth mechanisms will be highly required to push supramolecular chemistry to the next level, where access to nature inspired functions will be accomplished. In this contribution, I will present how reaction-diffusion (RD) conditions established within microfluidic devices can be used to uncover pathway complexity as well as to trigger pathway selection. Specifically, I will show that microfluidic RD conditions provide an unprecedented kinetic control over self-assembly processes; for example, enabling the isolation of well-defined kinetically trapped states as well as unprecedented metastable intermediates. This research provides a new tool to study and understand supramolecular chemistry, and opens up new avenues for the engineering of advanced functional.
Highly Functional Magnetic Miniature Robots

Guo Zhan Lum

Assistant Professor
Assistant Chair (International Engagement)
School of Mechanical & Aerospace Engineering
Nanyang Technological University
Singapore

Abstract: Miniature robots are mobile devices that are in the micro/millimeter length-scales. As these robots can exploit their size and mobility to non-invasively access highly confined and enclosed spaces, they have the potential to revolutionize targeted drug deliveries and minimally-invasive surgeries. Furthermore, miniature robots are proven to be powerful tools that can facilitate a wide range of fundamental studies in materials science and biology, as well as to enable critical manipulation tasks in various lab-on-chip applications. While the creation of the six-degrees-of-freedom (six-DOF) magnetic miniature robots is a recent major advancement in this technology, there exist two critical limitations that render these machines impractical; (i) under precise orientation control, these robots have slow sixth-DOF angular velocities (4 degree/second) and it is difficult to apply desired magnetic forces on them; (ii) such robots cannot perform soft-bodied functionalities. Here we introduce a fabrication method that can magnetize optimal miniature robots to produce 51–297 folds larger sixth-DOF torque than existing small-scale, magnetic robots. We also propose a universal actuation method that is applicable for rigid and soft magnetic miniature robots with six-DOF. Under precise orientation control, our optimal robots could execute full six-DOF motions reliably and achieve sixth-DOF angular velocities of 173 degree/second. Our soft magnetic miniature robots could display unprecedented functionalities; our six-DOF jellyfish-like robot could swim across barriers impassable by existing similar devices and our six-DOF gripper was 20 folds quicker than its five-DOF predecessor in completing a complicated, small-scale assembly. We had also created a highly dexterous magnetic miniature robot that had six-DOF motions and multimodal locomotion, and it could negotiate across highly complicated environments. We envision that this work will be able to inspire future miniature robots to become considerably more dexterous and capable for manipulation tasks.
Low-dimensional Semiconductor Materials for Stretchable Electronics and Tactile Sensing

Caofeng Pan
Professor
Beijing Institute of Nanoenergy and Nanosystems
University of Chinese Academy of Sciences
China

Abstract: Emulation of human senses via electronic means has long been a grand challenge in research of artificial intelligence as well as prosthetics, and is of pivotal importance for developing intelligently accessible and natural interfaces between human/environment and machine. In this talk, we present a novel design of nanowire LED arrays, which can be used to directly record the strain distribution by piezo-phototronic effect with a resolution as high as 2.7 μm, which is published in Nat. Photonics. Such sensors are capable of recording spatial profiles of pressure distribution, and the tactile pixel area density of our device array is 6250000/cm², which is much higher than the number of mechanoreceptors embedded in the human fingertip skins (~ 240/cm²).

When the device is under pressure, the images unambiguously show that the change in LED intensity occurred apparently at the pixels that were being compressed by the molded pattern, while those were off the molded characters showed almost no change in LED intensity. Instead of using the cross-bar electrodes for sequential data output, the pressure image is read out in parallel for all of the pixels at a response and recovery time-resolution of 90ms. Furthermore, our recent studies achieve such piezo-phototronic effect induced strain mapping in a flexible n-ZnO NWs/p-polymer LEDs array system. This may be a major step toward digital imaging of mechanical signals by optical means, with potential applications in touch pad technology, personalized signatures, bio-imaging and optical MEMS.

This research not only introduce a novel approach to fabricate Si-based or polymer-based flexible light-emitting components with high performances, but also may be a great step toward digital imaging of mechanical signals using optical means, having potential applications in artificial skin, touch pad technology, personalized signatures, bio-imaging and optical MEMS, and even and smart skin.

References:
Engineered Living and Dead Materials: From 3D Printable Enzyme Plastics to Living Bacterial Microreactors

Adam Willis Perriman
Professor
Professor of Bioengineering
UKRI Future Leaders Fellow
School of Cellular and Molecular Medicine
University of Bristol
UK

Abstract: Engineered Living Materials (ELMs) present an exciting opportunity to integrate and scale outputs from synthetic biology. ELMs are currently being developed for a wide variety of applications, which range from gut microbiome re-engineering to fungal-bacterial composite building materials. Ideally, the living component of an ELM or its output should interface with and modulate the bulk structure of material, by driving assembly or chemical processes from the nano to the macro length scales. Accordingly, we present recent and ongoing research on the development of smart highly fabricable composite bionanomaterials and engineered living materials with tuneable emergent properties. Specifically, we describe the development of enzymatically-active plastics [1] melts [2] and membranes [3] with robust structures, and a new class of bioink comprising an oxidoreductase-mediated interpenetrating network (IDE) gel with thermoresponsive shape changing properties that can be used to print living bacterial microreactors capable of detoxifying organophosphates under flow.

References:
Quantum Regimes of Coherent X-ray Generation with Strongly Correlated Electron Dynamics and Attosecond Rabi Oscillations for Advanced Nanoimaging

Tenio Popmintchev
Professor
University of California San Diego
USA

Abstract: Ultrafast femtosecond-to-attosecond imaging and spectroscopies using coherent EUV and X-ray light based on the extreme nonlinear process of high harmonic generation are already addressing grand challenges in complex molecular systems, advanced nanomaterials, and plasmas. The exquisite quantum control of the attosecond dynamics of the radiating electrons in this process makes it possible to sculpt the classical and quantum properties of light with unprecedented tunability of spectral, spatial, and temporal shape, and spin and orbital angular momentum state. The full spatial and temporal coherence of this unique light allows for multi-dimensional imaging at the extreme with a 4D spatial and temporal resolution of nanometers and femtoseconds, with access to an additional 5th dimension using the X-ray absorption fingerprinting of elemental and chemical specificity. Here, we present two novel regimes of coherent X-ray generation using short wavelength UV and EUV driving lasers where the design of the light properties are dominated by distinctive quantum dynamics in a simple He atom with two entangled electrons. In the first regime, using UV lasers, as a result of the strongly correlated dynamics of the helium electrons, we generate a secondary high harmonic plateau extending from the EUV up to the water window of the soft X-ray spectrum. Due to simultaneous recombination of two accelerated electrons, a single high-energy photon is emitted only when there are strongly entangled electron dynamics. This physical process paves a way to a sensitive attosecond-to-femtosecond spectroscopy as a probe of highly correlated electron-electron interactions in atomic and molecular systems, and similar physics might be able to reveal dynamics in strongly correlated phase transition materials and nanosystems of interest for quantum computing and superconductivity. In a second regime, where even shorter-wavelength EUV laser light drives the high harmonic generation, we predict that the macroscopic physics is favorably mitigating phase mismatching and group velocity mismatching effects in the soft X-ray region. Furthermore, on a single atom level, the emission is strongly enhanced, first, by the short wavelength driver where the quantum diffusion of the electrons is minimized, and second, by attosecond Rabi oscillations at resonance which lead to greatly suppressed ionization that otherwise would terminate the emission. Theoretically, this regime is scalable and holds the potential for a bright coherent light source at the technologically relevant EUV and soft X-ray wavelengths of interest for metrology with near-wavelength resolution and coherent printing. Our advances in coherent EUV and X-ray light generation and quantum control over light properties enable new insights into complex entangled dynamics and new applications in nanomaterials and quantum technologies.
References:


**Multifunctional Materials for Emerging Technologies**

**Federico Rosei**

Professor  
INRS Centre for Energy  
Materials and Telecommunications  
Institut National de la Recherche Scientifique, Varennes (QC)  
Canada

**Abstract:** This presentation focuses on structure property/relationships in advanced materials, emphasizing multifunctional systems that exhibit multiple functionalities. Such systems are then used as building blocks for the fabrication of various emerging technologies. In particular, nanostructured materials synthesized via the bottom–up approach present an opportunity for future generation low cost manufacturing of devices [1]. We focus in particular on recent developments in solar technologies that aim to address the energy challenge, including third generation photovoltaics, solar hydrogen production, luminescent solar concentrators and other optoelectronic devices [2-40].

**References:**

Quantum Regimes of Coherent X-ray Generation with Strongly Correlated Electron Dynamics and Attosecond Rabi Oscillations for Advanced Nanoimaging

Chanmin Su
Professor
Institute of Automation
Chinese Academy of Science
China

Abstract: Controls of the advanced manufacturing, such as semiconductor, OLED/LED display and precision optics, have long entered nanometer scale. The measurements of dimensional, physical, and chemical properties became essential part in recipe tuning, quality control and failure analysis. The presentation will focus on the scanning probe microscopy (SPM) and its increasingly important role in both metrology and fabrication processes. We will discuss in detail the application needs and technologies for cross-scale metrology measurements with the dynamic range from sub nanometer to sub-meter. The presentation will further discuss progresses in physical and chemical analysis based on SPM.
Characterisation of Hydrogen in Nanoporous Hydrogen Storage Materials via Neutron Scattering

Valeska Ting
Professor
Australian National University
University of Bristol
UK

Abstract: High surface area nanoporous materials such as porous carbon nanomaterials, zeolites and metal-organic framework materials are exceptionally suited for applications in gas separation and storage. Their nanoscale and macroscopic structures can be tuned to allow exceptionally high densities of gas within their pores, which can lead to exciting possibilities for energy storage, both by physical adsorption of alternative fuel gases such as hydrogen and through emergence of unusual materials states via gas densification. It can, however, be extremely challenging to characterise and study interactions of H₂ with nanoporous host materials due to hydrogen’s low electron density, which makes it difficult to detect in the presence of heavier elements using X-ray techniques.

Accordingly, we confined hydrogen in a range of nanoporous solids and used a combination of neutron scattering techniques under low temperatures (down to 10 K) and high pressures (up to 2 kbar) to elucidate the phase, interactions and behaviours of hydrogen inside porous materials with different pore sizes and geometries.

Here we will present results from various studies, highlighting different approaches for extracting key information from a range of hydrogen-containing materials. These include parametric studies and combinations of techniques including neutron scattering under static and dynamic conditions, gas sorption, molecular modelling and properties measurements under coupled extremes of low temperature and high pressures.

These results indicated the presence of molecular hydrogen arrangements with densities greater than that of solid hydrogen at its triple point, as well as the stabilisation of unusual configurations of hydrogen under a variety of temperature and pressure conditions. Such studies can produce surprising and useful insights into the effect of nanoconfinement on the atomic arrangement and properties of hydrogen under extreme environmental conditions, paving the way for developing new materials that will result in highly dense hydrogen phases for sustainable energy applications.
References:
Development of a Commercial Inspecting Tool for Detecting nm-size Phase Defects on a Multilayer EUV Mask Blank

Toshihisa Tomie
Professor
School of Physics
Changchun University of Science and Technology, China
National Institute of Advanced Industrial Science and Technology, Japan

Abstract: Lithography using EUV light, EUVL, which has been developed for 20 years in Japan, the United States, and Europe, has just started operation as a mass production technology for semiconductors. Two difficulties required the development for such a long time; one was the difficulty in increasing the power of the EUV light source, and the other was a technology for inspecting nm-size phase defects on a multilayer EUV mask blank. The circuit patterns of the semiconductor devices drawn on the mask blank are photo-printed on the resist coated on the Si wafer with a diameter of 300 mm with a reduction ratio of 4:1 to fabricate a huge number of transistors with a 10 nm half-pitch repetition frequency. An inspection machine is indispensable for developing mask fabrication technology with the number of defects as low as possible so that fabricated devices do not make a malfunction.

Concerning the latter, the inspection speed of the technology before 2001 was desperately slow for inspecting a full 140 mm x 140 mm area in a few hours. We needed to increase the inspection speed more than several thousand times. The requirements on the inspection technology are not only on the inspection speed. All defects below the size of 50 nm on the mask are to be detected with no failure. Another stringent requirement is that there should be no false signal so that they do not throw away a good-quality blank.

The second show-stopper was solved by developing technologies for materializing the author's invention in 2001 as a commercial tool through two national projects in Japan, the MIRAI, and the EIDEC projects, from 2001 until 2016. The first inspection machine, produced by the Lasertec cooperation, was introduced to the market in 2017, and a few companies have started the introduction of EUVL in their mass production lines.

The invention was the result of my research for over 20 years. In my talk, I explain the basic concept of the inspection enabling the several thousand-time speed-up.

From the middle of the 1990s, the author was also deeply involved in the first show-stopper; increasing the EUV power of the source for EUVL. The author will also refer to some epoch-making technologies in the 20-year history of the EUV source development.
Dynamic Structural Biology Driven by High-Speed Atomic Force Microscopy

Takayuki Uchihashi

Professor
Department of Physics/Institute for Glyco-core Research (iGCORE)
The Exploratory Research Center on Life and Living Systems (ExCELLS), National Institutes of Natural Sciences
Nagoya University
Japan

Abstract: Most biological phenomena in the cell are elicited by a cascade of extensive dynamic molecular processes, including protein conformational changes, binding and dissociation, assembly and degradation. A fundamental understanding of complex biological processes is inherently reducible to understanding the dynamics of a small number of molecules at each step in such a cascade. Since protein motions are usually asynchronous and often have a multimodal distribution that cannot be directly assessed by ensemble averaging methods, it is necessary to monitor and analyze the dynamic behavior of individual molecules using a dynamic structural biology approach based on single molecule observation.

Among various microscopic techniques for characterizing protein structures and functions, high-speed atomic force microscopy (HS-AFM) is a unique technique in that allows direct visualization of structural changes and molecular interactions of proteins without any labeling in a liquid environment. Since its emergence in 2001 [1], it has been applied to the dynamics analysis of various types of proteins, including motor proteins, membrane proteins, DNA-binding proteins, amyloid proteins, and artificial proteins [2-3] and now has now become a versatile tool indispensable to drive research based on dynamic structural biology.

In this talk, I will review several recent bioimaging applications realized by HS-AFM and show what kind of dynamics phenomena can be observed by HS-AFM. This review provides overviews of several recent bioimaging applications achieved by HS-AFM, classified into imaging studies of conformational dynamics and protein-protein interactions. Recent instrumental developments to extend the capabilities of HS-AFM, especially molecular manipulation by localized force application, one of the key features of AFM, will also be discussed.

References:
COVID-19 Vaccines Induce Protective Immunity Against Omicron Variant

Yuquan Wei
Professor
State Key Laboratory of Biotherapy and Cancer Center
West China Hospital, Sichuan University
China

Bio: Yuquan Wei, Academician of the Chinese Academy of Sciences, director of the State Key Laboratory of biotherapy of Sichuan University, director of the cancer center of West China Hospital of Sichuan University, CO editor in chief of the international magazine signal transmission and targeted therapy, and associate editor in chief of human gene therapy. In 1986, he graduated from West China Medical University with a master's degree in medicine. From 1991 to 1996, he studied abroad at the school of medicine of Kyoto University in Japan with a doctor's degree. He returned to China in 1996, mainly engaged in basic research, technology development and product research and development related to biological therapy and small molecule targeted therapy drugs for major diseases. The relevant research results have published more than 300 SCI papers in international magazines such as nature, nature medicine, PNAs and blood, and independently developed a number of vaccine biological drugs and small molecule targeted therapy drugs to cooperate with enterprises.
Abstract: Optofluidics is the use of light to control the flow of fluids with numerous applications such as drug delivery and lab-on-chip devices. This presentation briefly reviews our recent advancement on how to manipulate fluids through nano-micro materials and engineering in both experiments and simulation. We developed photoacoustic driving materials and light-induced deformation liquid materials based on the photoacoustic laser streaming and thermocapillary technique. I will report here, how we discover a series of novel phenomena, reveal the physical principles behind, and pave the way for a wide range of applications.
Abstract: As a typical representative of two dimensional (2D) semiconductors, group - IV chalcogenides have sparked considerable interest on account of its lattice structure, high compatibility with key semiconductor technology, and remarkable electrical and optical performance. Using group - IV chalcogenides with in-plane anisotropy as the photodetector's light absorption layer can effectively simplify the existing complex lens system, which can further promote device volume development toward miniaturization. Here, we demonstrate the application of polarizer-free polarization-sensitive photodetector/imagers made of 2D in-plane anisotropic layered semiconductors such as GeSe, SnSe, and GeAs, which are extremely sensitive to polarized light due to their reduced in-plane structural symmetry.
Abstract: We demonstrate the intriguing possibility of harnessing phonon sources, in particular, high frequency (10 MHz order) surface and hybrid acoustic waves, for synthesizing and manipulating two-dimensional and bulk crystals. In particular, we show that the large mechanical stresses that arise from the extraordinary surface acceleration of the acoustic wave-on the order of 10 million g’s, together with the intense electric field inherent in its electromechanical coupling, are capable of facilitating rapid synthesis of organic and inorganic crystals, as well as those of metal–organic frameworks (MOFs), often yielding novel crystal morphologies and structures. Moreover, the same process can be deployed to rapidly exfoliate bulk three-dimensional crystalline transitional metal dichalcogenides (TMDs; e.g., MoS$_2$) and carbides/nitrides (MXenes) into monolayer and few-layer nanosheets and quantum dots with high yield. Finally, the acoustic wave can be exploited for the manipulation of quasiparticles in these two-dimensional materials. For example, we show the possibility for reversibly modulating trion to exciton transition, and their subsequent transport and hence spatial separation within the material. In the case of the TMDs, we show with convincing evidence, that such novel phenomena can be attributed to their unique piezoelectric property, particularly when they exist in odd number of layers due to their broken crystallographic centrosymmetry.
Development of Lubricated Biomaterials for Various Biomedical Applications

Hongyu Zhang

Associate Professor
Department of Mechanical Engineering
Tsinghua University
China

Abstract: Various lubricated biomaterials including micro/nanoparticles, coatings, membranes, and hydrogels permit potential biomedical applications in the fields of osteoarthritis treatment, anti-bacteria, anti-adhesion, and tissue engineering. The typical biomaterials have attracted much attention from the researchers worldwide in the past few years. In this presentation, I will summarize recent progress on (1) the design and development of representative lubricated biomaterials such as nanoparticles, self-adhesive polymer coatings, electrospun nanofibrous membranes, and composite hydrogels, and (2) the preliminary biomedical applications of these lubricated biomaterials in joint lubrication enhancement, surface modification of biomedical devices, and tissue anti-adhesion.
# Technical Program

(ss: Technical Special Session)

**Wednesday, 2 August 08:00-10:00**

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<td>Nanoscience and Nanotechnology for Carbon Neutralization (ss)</td>
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<td>Nanometrology and Characterization</td>
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Novel 2D Materials-based Transistors, Memory and Sensors
He Tian*
School of Integrated Circuits & Beijing National Research Center for Information Science and Technology(BNRist), Tsinghua University

- Scaling down the transistor gate length and channel length to 0.34 nm and 10 nm, respectively
- Enable the 2D memory integrated with algorithm
- Graphene artificial throat with multi-mode recognition

These results indicated that 2D materials-based transistors, memory and sensors can be integrated together to build a more powerful system.

Multifunctional Wound Dressing for Monitoring and Treatment of Wound infection
Xiaofeng Wang, Lili Wang*
Institute of Semiconductors, Chinese Academy of Sciences & University of Chinese Academy of Sciences

- Multi-function wound dressing with multi-parameter integration and intelligent control of drug delivery was realized.
- The integrated sensor array can monitor temperature, pH, uric acid, and glucose level.
- The device can significantly inhibit bacterial growth and expedite wound healing

This technology may facilitate more timely and personalized wound management to improve chronic wound healing impression.

Neuromorphic Logical Transformation Based on Wafer-scale Synaptic Phototransistor Array
Zhexin Li, Zheng Lou*
Institute of Semiconductors, Chinese Academy of Sciences & University of Chinese Academy of Sciences

- Synthesis of 4 inches wafer scale semiconductor
- ~$10^7$ on/off ratio of phototransistor
- Specific detectivity of phototransistor is $8.17 \times 10^{14}$ Jones
- Transformation between ON/OFF and 'AND' gate based on optoelectronic control

This work contributed to wafer scale semiconductor fabrication and high-performance phototransistor integration, neuromorphic logical transformation was also demonstrated.
Study of Materials in 2D Limit for Non-volatile Data Memory

Xian-Bin Li
State Key Laboratory of Integrated Optoelectronics, College of Electronic Science and Engineering, Jilin University, Changchun 130012, China

- For phase-change memory, a combined study with DFT calculations and experiment explores the memory device performances of 4-nm-thickness Sb.
- For ferroelectric memory, we study a polarization switching dynamics for the promising In2Se3 ferroelectric materials in its monolayer limit.
- For resistive memory, we study the conductive mechanism in memristor at the thinnest limit: the case based on monolayer boron nitride.

The study will help to develop high-density integration non-volatile memory technology.

Investigation of Electrical Characteristics of A Novel FeFET-based Relaxation Oscillator

Chunsheng Jiang
School of Electronic and Information Engineering, Guangxi Normal University, China

- In this paper, we propose an emerging 1F1R1C relaxation oscillator. To study the working mechanism and electrical characteristics of the oscillator, an analytical model of drain current of long channel MFMIS FeFETs is deduced using Lambert function method at first. Moreover, we use our model to explain the influence mechanism of device geometrical dimensions and voltage bias on the oscillation frequency of the relaxation oscillator.

Figure (a) Schematic of the proposed 1F1R1C relaxation oscillator. (b) Output voltage ($V_o$) of a 1F1R1C relaxation oscillator for dissimilar FE thicknesses ($t_f$).
**02-1  08:00–08:20**

**Anisotropic Hydrogels with Multi-Scale Hierarchy based on Ionic Conductive for Flexible Sensor**

Xie Fu
Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences

- Ice pillar
- Cation: Na⁺
- Anion: citrate⁻
- PV A chain

**Notes:**

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**02-2  08:20–08:40**

**Optical Differentiation Based on Weak Measurement**

Junfan Zhu, An Wang, Fuhua Gao, and Zhiyou Zhang
College of Physics, Sichuan University, Chengdu 610064, China

- Optical differentiation is to realize differential operations by using only optical components.
- Optical differentiation can highlight features of images and thus be significant in image recognition.
- How to distinguish the positive and negative signs of the differential light fields has rarely been addressed.
- We propose a scheme to achieve the sign-distinguishability in an arbitrary order optical differentiation, based on the frame of weak measurement.

**Notes:**

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**02-3  08:40–09:00**

**Novel Electrochemical Immunosensor for the Detection of Liver Cancer Marker Alpha-fetoprotein**

Xiaozhan Yang
Department of Physics and Energy, Chongqing University of Technology, China

- Electrochemical immunoassay based on a novel nanomaterials Fe₃O₄/MWCNT-COOH/AuNPs
- A novel dual channel electrochemical fiber optic immunosensor
- A novel materials based on MXene and MOFs

**Notes:**
Ga$_2$O$_3$ nanowires synthesis for Deep UV Photodetector

Wenqiang Lu
Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences

1. Ga$_2$O$_3$/GaN nanowire p-n junction UV detector
2. IGZO nanowire film and UV detection performance
3. Improvement of Ga2O3-mxene heterojunction UV sensor performance
4. Improvement of Ga2O3-Gr heterojunction UV sensor performance

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PbS nanorods based NIR Photodetector
Chan Yang, Ruiyang Yan, Xinru Zhang, and Shuanglong Feng
Chongqing Institute of Green and Intelligent Technology, Chinese Academy of Sciences, Chongqing 400714, P R China

- Binary semiconductor nanomaterials have attracted widespread attention due to their unique optical and electronic properties, which are different from bulk materials.
- Highly crystalline 1D single-crystal lead sulfide (PbS) nanorods array was prepared by electrochemical atomic layer epitaxy (ECALE) method.
- Through polarization studies on graphene substrates, SEM images and XPS spectra, we confirmed the critical role of gold-thiolate in the vertical rod-like growth of PbS.
- The PbS array-graphene heterostructure heterodetector presents an extraordinary photoresponsivity in 1.55 μm at room temperature.
03-1 08:00–08:20

High-Speed Communication over Terahertz Fiber and its Challenges on Terahertz Material

Hao Long
B&P Lab, Huawei, China

- Investigating the application scenarios driving the research on high speed terahertz fiber communication.
- Summarizing the primary objectives should be achieved for terahertz fiber communication to be competitive.
- Providing a general review of the works on terahertz fiber design and materials.
- Discussing the challenges on terahertz fiber material including the dielectric characters and its measurement.

03-2 08:20–08:40

Integrated Continuous Terahertz Generation Through Engineering Miniband of Hybrid Optical-terahertz Superlattice

Hui Liu
School of Physics, Nanjing University, China

- A hybrid optical-terahertz superlattice waveguide (HOTSW) is proposed for THz radiation.
- Our approach leverages a lithium niobate-on-insulator (LNOI) optical waveguide and a THz spoof surface-plasmon-polaritons superlattice waveguide.
- We demonstrate significantly enhanced nonlinear coefficient during the difference frequency generation (DFG) process.
- Our proposed THz radiation source holds implications for facilitating 6G high-speed wireless communications.

03-3 08:40–09:00

Dynamic Terahertz Metasurface for Thermally Controlled Encryption

Lingling Huang
School of Optics and Photonics, Beijing Institute of Technology, China

- Combined with the phase-change material VO₂;
- Use global temperature modulation with shorter completion time;
- Fabricated with two-step lithography and good fabrication quality is obtained;
- One or two secret images can be encrypted reversely.
03-4 09:00–09:20

Metasurfaces for Terahertz OAM Based Multiplexing
Jianqiang Gu
Center for Terahertz Waves, Tianjin University, China

- Metasurface generates superposed terahertz OAM beams dependent of LCP and RCP incidences.
- Metasurface generates multiple terahertz OAM beams with divergent angles independent of carried topological charges.
- Multidimensional MDM + PDM terahertz OAM demultiplexing demonstrated with metasurface-based OAM converters.

03-5 09:20–09:40

Enhanced Sensing of THz Trace Molecular Fingerprint by Multiplexed Dielectric Metasurface
Jinfeng Zhu
Institute of Electromagnetics and Acoustics and Key Laboratory of Electromagnetic Wave Science and Detection Technology, Xiamen University, China

- Dielectric metasurfaces have great potential on trace terahertz fingerprint sensing due to their low loss.
- The significant difference of thickness between the trace sample and metasurface makes the dielectric optical loss not negligible.
- There are challenges for the conformal coating of trace sample on the uneven surface of dielectric metasurface.
- In this report, we will discuss the studies of overcoming the dielectric loss and sample coating.

03-6 09:40–10:00

Deep sub-wavelength terahertz near-field imaging enabled by optically controlled spatial modulator
Jiang Li1, Sichao Chen1, Qiwu Shi2, Li-guo Zhu3
1Institute of Fluid Physics, China Academy of Engineering Physics, China
2College of Material Science and Engineering, Sichuan University, China

- A novel terahertz near-field imaging without mechanical raster scanning is proposed
- A minimum resolution of over λ/100 is demonstrated
- Time of flight terahertz microscopic topography with sub-wavelength resolution is demonstrated.
Nanoscale Oxide Semiconductor Transistors by Atomic Layer Deposition

Mengwei Si
Department of Electronic Engineering, Shanghai Jiaotong University, China

- Ultrathin oxide semiconductor down to sub-1 nm by ALD
- High mobility > 100 cm²/V·s, high drive current > 3 A/mm, SS down to 63.8 mV/dec at room temperature
- Material and device engineering by quantum confinement effects

One-dimensional van der Waals heterostructures for electronics and optoelectronics

Jing-Kai Qin
School of Materials and Science Engineering, Harbin Institute of Technology (Shenzhen), China

- 1D+nD (n = 0~3) vdW heterostructures demonstrate promising applications in future electronics and optoelectronics
- FET based on 1D Te-BNNT nanowire shows high current capacity (~1.5 × 10⁶ A·cm⁻²) with tunable transport behavior
- 2D SnP₂Se₉ combined with 1D SiN waveguide can be used for monolithic on-chip electronic-photonic integration

Noninvasive Atomic-Layer Etching of van der Waals Semiconductors for Electronics

Songlin Li
School of Electronic Science and Engineering, Nanjing University, China

- To report the multiparametric survey on the kinetics of lateral photooxidation in WS₂ and MoS₂ monolayers
- Devised a noninvasive atomic-etching strategy via photodelamination in layered semiconductors
- Devised another CMOS-compatible atomic-etching protocol for layered semiconductors via controllable alloying and subsequent wet etching
Multimodal modulation of memory and synaptic devices
Ye Zhou
Institute for Advanced Study, Shenzhen University, China

- Optoelectronic synapses provide a non-contact method and overcome the shortcomings of electrical synapses
- Optical operation is capable of offering a confined stimulation with ultrahigh spatial and temporal resolution
- The optoelectronic device can ensure fast signal transmission and high energy efficiency

Cold Source Devices Beyond the Switching Limits
Fei Liu
School of Integrated Circuits, Peking University, China

- Switching limit of conventional transistor and diodes
- Realize steep switching by source density of states engineering
- Design cold source transistors and diodes beyond the switching limits

Contact Engineering for Two-Dimensional Field-Effect Transistors
Yuda Zhao
School of Micro-Nano Electronics, Zhejiang University, China

- A stable carrier doping method via the mild covalent grafting of maleimides on the surface of MoS₂
- Negligible impact on the electron transport of MoS₂ and high thermal stability (above 300 °C)
- The contact resistance can be greatly reduced by ~12 times after molecular functionalization
- The Schottky barrier of 44 meV is achieved on monolayer MoS₂ FETs
Pattern transformation rates control of magnetic microrobotic swarms

Li Zhang
Department of Mechanical and Automation Engineering, The Chinese University of Hong Kong, Hong Kong, China

- Construct a theoretical model to characterize magnetic and hydrodynamic interactions within the microrobotic swarms
- Elucidate the influences of magnetic field parameters on pattern transformation rates of microrobotic swarms
- Propose strategies to control pattern transformation rates of magnetic microrobotic swarms
- Validate transformation rates control strategies in various environments

IEEE 3M-NANO 2023
Nanorobots for Tumor Treatment

Chun Mao
Nanjing Normal University, China

- Improving the cell uptake rate of drug loaded nanorobots
- Enhancing tumor tissue penetration of drug loaded nanorobots
- Improving the physiological barrier breaking ability of drug loaded nanorobots
- Improving the targeting of drug loaded nanorobots

Microalgae-Derived Swimming Microrobots

Xiaohui Yan
School of Public Health, Xiamen University, China

- High-yield production at low cost
- Multiple functions integrated from microalgae
- In vivo effective actuation and propulsion achieved under multimodal imaging-based tracking
- High therapeutic efficacy with favorable degradation and biocompatibility
Marriage of piezoelectric materials and magnetically driven microrobots: biomedical applications

Xiangzhong Chen
Institute of Optoelectronics, Fudan University, China

- Microrobots are emerging candidates for targeted therapeutic interventions.
- The implementation of piezoelectric building blocks can help develop highly-integrated small-scale machines.
- These magnetoelectric micro devices can wirelessly generate electric output.
- These micro devices find applications in biomedical field such as cell stimulation and drug delivery.

Microrobotic Swarms for Biomedical Applications

Jiangfan Yu
School of Science and Engineering, The Chinese University of Hong Kong, Shenzhen, China

- Ribbon-like microrobotic swarms can perform reversible pattern reconfiguration.
- By proposing a hierarchical radar strategy, microrobotic swarms are navigated to targeted positions while avoiding dynamic obstacles.
- Microrobotic swarms are developed for embolization in targeted region with high precision.
Electron Beam and EUV Patterning with Fullerene-based Resists

Dongxu Yang
Institute of Optics & Electronics,
Chinese Academy of Sciences, China

- Multiple exposure mechanism of fullerene and its derivatives was reviewed
- Fullerene derivatives showed remarkable potential in high-resolution EBL and EUV patterning
- The flexibility in side-chain engineering of fullerene derivatives enables development of novel functional resist materials

Directed self-assembly lithography for contact/via patterning

Shisheng Xiong
School of Information Science and Technology,
Fudan University, China

Directed self-assembly (DSA) of block copolymers generates periodic arrays with feature size of the 3-50 nm. We fabricate contact/via patterns through graphoepitaxy DSA lithography. Contact hole shrinking and multiplication were induced by the topographic hole pattern. Defect-free processing window of the contact hole shrinkage was improved via block copolymer blending. Self-consistent field theory (SCFT) simulation supports the experimental results. This paper provides a promising strategy to fabricate contact/via patterning for the sub-7 nm technology nodes.

Directed Self-assembly of High-χ Block Copolymers on Chemical Patterns for Sub-10 nm Patterning

Shengxiang Ji
Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, Changchun, China

- Developed several block copolymers with higher χ than PS-b-PMMA
- Achieved perpendicular orientation of block copolymer domains on neutral brushes under thermal annealing
- DSA of PS-b-PMA (Lo=14nm) with density multiplication on patterns
- Achieved 8nm HP AIOx gratings by SIS
07-4  09:00–09:20

**Self-Assembly of Silicon-Containing Block Copolymers and Their Potentials in DSA**

LingYing Shi  
College of Polymer Science and Engineering, Sichuan University, China.

- Silicon-containing BCPs possess high $\chi$ values for strong microphase separation and native etch contrast for facile pattern transfer
- Liquid crystalline Si-BCPs present LC ordering in microphase-separated nanostructures
- Interfacial anchoring and external field can be utilized to manipulate the nanostructure orientation
- DSA of Si-BCP yields SiO$_x$ nano lines and meshes oriented either parallel or transverse to sidewalls

07-5  09:20–09:40

**Hierarchically engineered nanostructures from Janus-type molecular brush block copolymers**

Xiaowei Fu  
State Key Laboratory of Polymer Materials Engineering, Polymer Research Institute, Sichuan University, Chengdu 610065, China.

- Hierarchical assembly of Janus-type molecular brush
- Independently tailored superstructures and substructures
- Formation of heterostructures based on molecular design of Janus-type molecular
**Gate-tunable 2D materials based photodetection**

Zegao Wang  
College of Material Science and Engineering, Sichuan University, China

- Dual-gated WSe$_2$ phototransistor is prepared.
- By applying the dual-gate voltage, the photocurrent has large tunable.
- Due to the tunable Fermi level of WSe$_2$, the distance between the Fermi level and trapping energy, recombination level can be electrically tuned, thus, the photodetection exhibits superlinearlity, linearity and sublinearlity behaviors.
- The photoresponse wavelength can be effectively tuned from 1100 nm to 870 nm.

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**In-situ nanoscale van der Waals “touch” for high-quality heterostructure interfaces**

Huan Hu  
ZJU-UIUC Institute, International Campus, Zhejiang University, China

- AFM contact scanning removes bubbles & contaminations
- Super smooth nano-spherical tip induces minimal damages
- Reduce gap & promote interlayer interactions
- In-situ treatment & examination and promising in improving heterostructure device performances

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**Doping engineering of OTFT and its application in neuromorphic computing**

Wenwu Li  
Institute of optoelectronics, Fudan University, China

- The performance of OTFTs are significantly improved through p-type interface doping engineering
- The contact resistance and trap density state of OTFTs are reduced by organic salt doping
- The multi-functional neuromorphic computing is realized through lewis acid doping of OTFTs.
An Efficient Artificial Visual Perception Nervous System with Optoelectronic Memristor

Xiaobing Yan
Key Laboratory of Brain-Like Neuromorphic Devices and Systems of Hebei Province, Hebei University Baoding 071002, P. R. China

- We propose a fully memristor-based artificial visual perception nervous system (AVPNS).
- AVPNS consists of an optoelectronic memristor, a threshold switching (TS) memristor and an electrochemical actuator.
- AVPNS can simulate the eye muscle contraction and reproducing the self-protection response of closing eyes when the human eyes are injured by intense light.
- The system achieves a fast response speed and a large response current of up to 40 µs and 0.8 µA.

Graphene/Truncated-Silicon-Nanocone UV Photodetector

Feng Tian, Shaoxiong Wu, Xinyu Liu, Yuda Zhao, Huan Hu*, Yang Xu*
School of Micro-Nano Electronics, Zhejiang University, China

- Graphene/Truncated Silicon Nanocones
- Nanosphere Lithography + ICP
- Reduced reflectivity of silicon to 12% (in UV range) by light trapping effect
- $R = 0.32$ AW; EQE $> 113\%$ (@360 nm)
- Analysis of interface quality of Graphene/Silicon-Nanocones
C-entrapped Cu nano-peanuts for Nitrite Detection in Flood-Affected Ground Drinking Water

Waseem Abbas
Institute of Physics, Bahauddin Zakariya University, Multan, Pakistan

- Designed carbon-entrapped copper nanoparticle (C@Cu-NPs) nanohybrid and modified with ionic liquid.
- Modified electrode showed excellent electrocatalytic oxidation efficacy towards NO$_2^-$ ions.
- The electrode had low detection limit, high sensitivity, and wide linear range.
- The electrode employed for Nitrite Detection in Flood-Affected Ground Drinking Water

Si Nanowires-holes Arrays with Enhanced Wettability

Sadaf Saeed
International Research Centre for Nano Handling and Manufacturing of China
Changchun University of Science and Technology
Changchun 130022, China

- Fabrication and characterization of nanostructured Si (NWs-NHs) arrays with improved wettability properties.
- The experiments were conducted to evaluate the wetting behavior of different liquids on the nanostructures surfaces.
- The article discusses potential applications of the nanostructured Si (NWs-NHs) arrays, such as anti-fog coatings, self-cleaning surfaces, and microfluidic devices.

DYNAMO: AMAZON’S HIGHLY AVAILABLE KEY-VALUE STORE

Sana Khan
Computer Science and Engineering, University of Lahore, Pakistan

- This report presents the design and implementation of Dynamo, a highly available key-value storage system that some of Amazon’s core services use to provide an “always-on” experience.
- To achieve this level of availability, Dynamo sacrifices consistency under certain failure scenarios.
- It makes extensive use of object versioning and application-assisted conflict resolution in a manner that provides a novel interface for developers to use.
Influence of In-Situ Chemical Polymerization on the Electrical Properties of PANI-NiO Composite

Ali Zia
School of Optical Engineering, Beijing University of Technology, Beijing, China

- Investigates the influence of in-situ chemical polymerization on the structural and electrical properties of polyaniline-nickel oxide (PANI-NiO).
- The presence of conductive nickel oxide nanoparticles within the PANI matrix is responsible for the increased electrical conductivity.
- This study's findings emphasizing their potential applications in various electronic and sensing devices.

Research progress on anti-tumour, anti-microbial and anti-viral activities of crocodile blood

Tianzhu Yu
Centre for Opto-Bio-Nano Measurement and Manufacturing
Zhongshan Institute of Changchun University of Science and Technology, Zhongshan, China

- Existing research have shown that crocodile blood has good anti-tumour, anti-microbial and anti-viral properties.
- In-depth studies on the components and functional characteristics of crocodile blood and its exploitation are the topics of current research.
- The identification of beneficial components and further animal research are essential for the medicinal development of crocodile blood.

Optical Super-resolution Diagnostics: A Review of Sub-wavelength Measurements and Applications

Peter Bryanston-Cross
School of Engineering University of Warwick UK Centre for Nano Metrology

- Holographic Diffraction Imaging Microscope (HDIM)
- Olympus Microscope Spinning Disc (OSM)
- Ptycho- graphic Illumination Microscopy (PIM)
- Stimulated Emission Depletion (STED) Microscopy
- Stochastic Optical Reconstruction Microscopy (STORM)
- Photoactivated Localisation Microscopy (PALM)
A New Simulation Method for 3-D Electron Beam Lithography
Yi-Shuo Chen
Key Laboratory of MEMS of Ministry of Education, Southeast University, People’s Republic of China

• This paper proposes a method for simulating three-dimensional electron beam lithography
• This paper applies Monte Carlo method to establish an electron beam scattering energy loss model
• Obtain a three-dimensional development contour map and compare it with experimental results

MXene-Germanium Schottky Heterostructures for Ultrafast Broadband Self-Driven Photodetectors
Shenjiali Wang, Guoliang Xiong
School of Science, Chongqing University of Technology, PR China

• MXene/n-Ge Schottky heterostructures are fabricated by a simple drop-casting method.
• The MXene/n-Ge device exhibits excellent photoresponse from 365–1550 nm.
• The photodetector shows an excellent on/off ratio (~10^4) and a response speed of 1.4/4.1 µs.
• A highspeed broadband self-powered photodetector can work normally at low temperature (73 K).

3D urchin–like CoVO/MXene nanosheet composites for enhanced detection signal of nitrite
Haotian Wu, Jinghao Zhuang
School of Science, Chongqing University of Technology, PR China

• Urchin–like CoVO/TiC2Tx was obtained by hydrothermal and self-assembly.
• Density-functional theory has been employed to investigate the interfacial properties of CoVO/TiC2Tx.
• CoVO/TiC2Tx composite exhibited obvious enhanced signal to nitrite detection.
• The composite is a novel candidate for electrochemical sensors in food safety.
Research Progress of Terahertz Nondestructive Testing on Composite Material
Liuyang Zhang, Yafei Xu, Xingyu Wang, Yuqing Cui, Rong Wang
School of Mechanical Engineering, Xi’an Jiaotong University, Xi’an, China

• Dispersion compensation strategy based on a double Gaussian mixture model to suppress the dispersion effect in THz echoes.
• End-to-end 3D THz representation system based on deep learning methods to enable automatic defect location.
• Intelligent THz 3D characterization system based on the deep adversarial domain adaptation strategy.
• Different Strategy to improve THz NDT in the industrial applications.

Notes:

C-scan THz image before and after the THz signal processing.

Metamaterial–Graphene Hybrid Multifunctional Terahertz Detector
Yingxin Wang
Department of Engineering Physics, Tsinghua University, China

• Integrated, multifunctional and low-cost terahertz sensing devices are highly desired for scientific and industrial applications.
• Combine local field manipulation and enhancement characteristics of metamaterial and hot-carrier-assisted photothermoelectric effect in graphene.
• Propose a monolithic device with simultaneous functions of photodetection, wavelength and polarization selective imaging.

Notes:

Schematic of the device and two-color imaging results.

Spatial Modulation of Terahertz Beams for Imaging and Scanning Applications
Jierong Cheng
Institute of Modern Optics, Nankai University, China

• Spatial modulation of THz beams by functional materials usually suffer from limited aperture size, pixel crosstalk and energy consumption.
• Here various spatial modulation patterns are hidden into a single passive dielectric metasurface through frequency demultiplexing.
• Single-pixel imaging application is demonstrated in the THz-TDS system.
• Wide-angle beam scanning is realized by twisting two passive metagratings.

Notes:

(a) frequency-multiplexed spatial light modulation for single-pixel imaging. (b) beam scanning.
Terahertz wavefront modulation and coded-aperture imaging with programable metasurface
Chenggao Luo
National University of Defense Technology, China
Special Session: Functional Materials for Terahertz Manipulation
1. Research status at home and abroad
2. Terahertz wavefront modulation and beam forming with programable metasurface
3. Terahertz coded-aperture imaging: key technologies and progress

Dual stimuli-triggered programmable terahertz metamaterials
Bo Zhang
Department of Physics, Capital Normal University, China
• A novel approach was explored, involving a dual stimuli-triggered programmable terahertz metamaterial based on indium oxide (In2O3). This metamaterial can be triggered to respond either by photoexcitation or rotating. When exposed to light irradiation, the resonant frequency undergoes a blue shift of up to approximately 100 GHz compared to the original frequency. Terahertz transmissions were utilized as coded pixel units and programmably modulated using binary-order signals or color codes achieved through photoexcitation or rotation.

Figure 1 Schematic of the terahertz time-domain spectroscopic system and the sample used in this study.
Technical Special Session 11
Ultra-fast Laser Micro/Nanofabrication Technologies and Applications (ss)
Room 4
10:20-12:20 Wednesday, 2 August
Chair: Qidai Chen
Co-Chair: Dezhi Tan

11-1 10:20–10:40

Ultrafast laser induced structure manipulation in glass
Dezhi Tan
Zhejiang Lab, China

- We demonstrated three-dimensional (3D) direct lithography of perovskite nanocrystals (PNCs) with tunable composition and bandgap in glass by using ultrafast laser direct writing. The halide ion distribution was controlled at the nanoscale with ultrafast laser-induced liquid nanophase separation. Thus, the full-color printing of PNCs with PL tuned in a range from 480 to 700 nm was achieved. Printed 3D structures in glass were used for optical storage, micro-light emitting diodes, and holographic displays.

11-2 10:40–11:00

Ultrafast laser annealing and applications
Xuewen Wang
International School of Materials Science and Engineering, Wuhan University of Technology, China

- Pulsed laser annealing has been applied in many thin film semiconductor manufacturing.
- We here show the annealing technique using ultrashort laser pulses.
- It shows great potential in the new photovoltaic and thermalelectric applications.

11-3 11:00–11:20

High Efficiency Two Photon Lithography
Hui Gao
Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, China
Optics Valley Laboratory, China

- Inertia-free acousto-optic scanning method with spatial-switching multi-spots was proposed.
- A record-high 3D printing rate of $7.6 \times 10^7$ voxel/s was demonstrated, which is nearly one order of magnitude higher than earlier scanning methods.
- Multi-foci metalens was firstly used to replace objective to simplify system design and improve printing efficiency.
Interface absorbance/reflectance modulation by femtosecond laser ablation structuring
Dongshi Zhang
Shanghai Jiao Tong University
Shanghai, China

- Femtosecond laser ablation of metals in an organic solvent has been used to generate hybrid nanostructured cross-linked ultrahigh/low spatial frequency laser induced periodic surface structures (UHSFLs/LSFLs), which well mimic antireflective architecture of Ornithoptera goliath [1]
- The feasibility to develop tunable iridescent antireflective surfaces via simultaneous synthesis of functional metal-oxide nanomaterials, in situ deposition and hierarchical LIPSS nanostructuring by means of femtosecond laser ablation (fs-LA) of tungsten (W) and molybdenum (Mo) in air has also been demonstrated [2]

Anisotropic photoelectric response of GO film high-speed structurized via femtosecond laser
Wei Xin
Department of Physics, Northeast Normal University, China

- Novel form processing technology by using femtosecond laser
- Large-area, high-speed, high-quality micro-nano grating structure manufacturing of GO material
- Anisotropic photoelectric applications (photodetection and birefringence)
- Corresponding author of the paper

Design and laser fabrication of biomimetic antireflection structures
Xueqing Liu
College of Electronic Science and Engineering, Jilin University, China

- Femtosecond laser deep scribing technology in combination with etching process was proposed.
- Realized the moth-eye inspired antireflective window with sub-wavelength pyramid arrays on sapphire.
- The antireflective window shows broadband (3–5 μm) and high transmittance (98% at 4 μm, the best results reported so far).
- High-quality and large area (1 cm * 1 cm) sapphire window was realized.
Design of a flexure nano-positioning stage based on ETC type two-axis flexure hinges

Huaxian Wei, Zhouwu Chen, Zhaoyin Cai, Xinjie Pan
Department of Mechanical Engineering, Shantou University, Shantou, China

- A decoupled-asymmetric XYZ translational nano-positioning stage is developed based on the ETC two-axis flexure hinges.
- The motion characteristics of the flexure stage are investigated and compared with traditional flexure stage.
- The maximum stresses and the actuating forces decreased under identical displacement actuation.

Disturbance Observer-based Repetitive Control With Application To Fast Tool Servo System

Pengbo Liu
School of Mechanical Engineering Qilu University of Technology Jinan, China

- A modified Disturbance Observer (DOB) based on repetitive control structure to FTS.
- The controller optimization is translated into $H_{\infty}$ and DOB optimization.
- Obtain the optimal filter.
- The experiments demonstrated the good tracking, robustness and anti-interference performance of the proposed control system.

Modeling and Analysis for Triaxial Flexure Mechanisms with Symmetric Overconstrained Configurations

Jian Yang, Peng Yan*
Key Laboratory of High-Efficiency and Clean Mechanical Manufacture Ministry of Education, School of Mechanical Engineering, Shandong University Jinan, 250012, China

- A triaxial translational compliant mechanism design is proposed by employing diverse flexure elements and overconstrained symmetric configuration.
- A generalized theoretical model is established to incorporate those utilized flexure elements into a unified framework.
- The characteristics of the stage with symmetric configuration are investigated through a key parameter study.
**Technical Special Session 12**
*Design, Analysis and Control of Nano-manipulating Systems (ss)*
Room 5
10:20-12:20 Wednesday, 2 August
Chair: Zhen Zhang
Co-Chair: Peng Yan

### 12-4 11:20–11:40

**Galvo based In-situ Imaging and Inspection System with Variable Ranges and Resolutions**
Yuxuan Cao, Kuai Yang, Zhen Zhang
Department of Mechanical Engineering, Tsinghua University, China

- A novel in-situ imaging and inspection system.
- Variable ranges and resolutions, taking both speed and clarity into account.
- Implementing a blind deblurring method to enhance the image quality.
- Potential of achieving in-situ laser processing and inspection.

### 12-5 11:40–12:00

**Modeling and Analysis for Triaxial Flexure Mechanisms with Symmetric Overconstrained Configurations**
Jian Yang, Peng Yan*
Key Laboratory of High Efficiency and Clean Mechanical Manufacture Ministry of Education, School of Mechanical Engineering, Shandong University, Jinan, 250012, China

- A triaxial translational compliant mechanism design is proposed by employing diverse flexure elements and overconstrained symmetric configuration.
- A generalized theoretical model is established to incorporate those utilized flexure elements into a unified framework.
- The characteristics of the stage with symmetric configuration are investigated through a key parameter study.
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Technical Special Session 14  
Materials and Processes for Advanced Nano-Patterning (ss)  
Room 7  
10:20-12:20 Wednesday, 2 August  
Chair: Dongxu Yang  
Co-Chair: Shengxiang Ji

14-1 10:20–10:40

Nano-resolution critical dimension and roughness metrology for advanced material and process development  
Libin Zhang  
Institute of Microelectronics, Chinese Academy of Sciences, Beijing China

• Monte-Carlo and edge detection methods are used and compared for increasing the metrology resolution in advanced R&D.
• A systematic analysis on how to improve the CD and roughness metrology accuracy is given.
• PSD is applied to extract the low frequency roughness for the development of DUV and EUV materials.

14-2 10:40–11:00

EUV-IL technology and applications in SSRF  
Yanqing Wu, Jun Zhao, Shumin Yang, Chaofan Xue, Jiali Long, Renzhong Tai  
SSRF, Shanghai Advanced Research Institute, CAS, China

• EUV interference lithography (EUV-IL) based on synchrotron radiation (SR).
• As an EUV photoreisnt test tool, SSRF EUV-IL station is moving towards 5nm technique node.
• Based on this SR beamline-station, a variety of EUV-IL/XIL methods has been developed to meet user requirements.

14-3 11:00–11:20

Femtosecond laser fabrication of cross-scale micronano structures and applications  
Mei-Ling Zheng  
Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, China

• Introduction of the cross-scale micronano structures
• Femtosecond laser fabrication technique
• Materials design and preparation
• Fabrication capability of cross-scale micronano structures
• Applications of the cross-scale structures in optical devices and cell topography
**Size-selected cluster beam technology for surface treatment at atomically precise control**

Lu Cao  
Nanjing Atomic Manufacturing Research Institute, China

- Gas clusters are aggregates of gas atoms, typically containing 2-100,000 atoms.
- Cluster beam technology can achieve atomically precise control of cluster atomic number and beam energy.
- Precise control of collision momentum, etching effect, and heat dissipation during the interaction between gas clusters and wafers/device.
- For fine surface treatment in IC fabrication, including cleaning, etching, and planarization.

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**Flexible Transparent Electrodes Formed from Template-Patterned Thin-Film Silver**

Sihai Luo  
Department of Chemistry, Norwegian University of Science and Technology (NTNU), Norway

- We have fabricated flexible, transparent, ultrasmooth-thin silver (Ag) electrodes by using a maskless deposition process.
- Insulating regions may be defined within an otherwise conducting Ag film by selectively plasma etching a polymer before metal deposition.
- An Ag electrode pattern was formed by using a vacuum evaporation without any additional process.
Technical Special Session 15
2D Materials at Nanoscale: From Fundamentals to Applications (ss)
Room 1
14:00-16:00 Wednesday, 2 August
Chair: Zegao Wang
Co-Chair: He Tian

15-1 14:00–14:20
Laser writing of spin structures in PDMS/PI
Hao Guo, Yue Qin
State Key Laboratory of Dynamic Measurement Technology, North University of China, China
- Laser writing of multi-nanocrystalline SiC by selectively crosslinking C-Si bonds in PDMS/PI.
- Femtosecond laser direct writing of spin ensemble structures in nanocrystalline SiC.
- Applying spin structures in PDMS/PI substrate in the field of flexible sensing, security encryption, and so on.

15-2 14:20–14:40
Photodetectors Based on MXene/TiO₂ Interface Engineering
Huajing Fang
School of Materials Science and Engineering, Xi’an Jiaotong University, China
- Fully Transparent Ultraviolet Photodetector with Ultrahigh Responsivity was developed by interface engineering.
- Local junctions exert a giant photogating effect under illumination, facilitating the separation of photogenerated carriers.
- Transparent photodetector has been successfully applied in a UV index wireless sensing system.

15-3 14:40–15:00
Two-Dimensional Organic Crystals: from Fabrications to Neuromorphic Computing
Yun Li
School of Electronic Science & Engineering, Nanjing University, China
- Advanced techniques for solution-processed fabrications of high-quality 2D organic crystals.
- Field-effect transistors with high charge mobility and low contact resistance.
- Investigation of charge behaviors.
- Advanced optoelectronic devices for neuromorphic computing.
2D Wide Bandgap Materials for Electronic and Optoelectronic Devices

Yangbo Zhou
School of Physics and Materials Science, Nanchang University, China

- The properties for a series of 2D materials with large band gaps are investigated.
- 2D transistors were assembled using layered MnAl$_2$S$_4$ or oxidized 2D materials as gate dielectrics.
- Large on-off ratio, low subthreshold swing values with ultrasmall hysteresis were achieved in such transistors.
- Light induced resistive switching and optoelectronic synapse behaviors in Nb$_4$P$_2$S$_21$ nanobelts.
- Author contribution: Fang Xu, Guangjian Liu, Junqing Guo, and Yangbo Zhou.

Stability of CsPbBr$_3$ Perovskites quantum dots and Their White Light Emission Devices

Zhigang Zang, Shuangyi Zhao
College of Optoelectronic Engineering, Chongqing University, China

- DA can be used as ligand for CsPbBr$_3$ QDs and greatly enhance the stability of CsPbBr$_3$ QDs.
- ASE and lasing performance of CsPbBr$_3$ QDs is greatly enhanced by using DA ligand.
- High performance of WLEDs based on CsPbBr$_3$ QDs are demonstrated.
Extracellular Protein Crystallization by Self-Assembly
Mingdong Dong
INANO, Aarhus University, Denmark

Amyloid self-assembly is a complex phenomenon with implications in human disorders and materials science. This study aims to understand the formation of macroscopic crystals and explore reversible assembly by examining temperature, pH, ionic strength, and solvents. In situ microscopy will be used to investigate amyloid disassembly dynamics. Understanding the influence of external factors on crystal formation provides insights into amyloid mechanisms and biomaterial design strategies.

Peptide based biointerface for tumor cell detection and isolation
Lei Liu
liul@ujs.edu.cn
Institute for Advanced Materials, Jiangsu University, Zhenjiang, 212013, China.

- Sugar responsive peptide based smart biointerface for CTC isolation
- Pattern dynamic biointerface and lubricant infused surface for CTC isolation in blood sample
- Peptide based soft film with dynamic biointerface for CTC isolation in patient’s blood samples

Insights into Light-induced Micropatterning on the Nanoscale
Anne-Kathrine Kure Larsen1,2,3, William Pallisgaard Olesen1, Mingdong Dong1
1Interdisciplinary Nanoscience Center, Aarhus University, Denmark. 2Sino-Danish Center for Education and Research, Aarhus, Denmark. 3University of the Chinese Academy of Sciences, Beijing, China.

- Light-induced micropatterning of PLL-g-PEG to create patterns with varying bioadhesion for multiple applications
- PEG cleavage controlled and visualized
- Relating fluorescence intensity of adhered proteins with particle coverage using AFM
- Micropatterns utilized for mimicking ECM protein gradients to study cell response

Fluorescence intensity relation to particle coverage using AFM
SERS-Active MOF Sensors for Ultrasensitive and Multiplex Detection of biomarkers

Min Li
Institute of High Energy Physics, Chinese Academy of Sciences, China

- The application of MOFs as SERS-active platforms in multiplex VOCs detection is still unexplored.
- MIL100(Fe) was firstly demonstrated to serve as an ideal SERS-active substrate for biomarkers’ capture and recognition in both air and liquid phases.
- 2D porphyrin-based MOF was used for diagnosis of Helicobacter pylori infection through the specific detection of ammonia in human exhalation.

Nanoporous Ti surface promotes osteogenesis by suppressing osteoclastogenesis

Wen Song
Department of Prosthodontics, School of Stomatology, The Fourth Military Medical University, China

- Nanotubular Ti surface promotes osteoblasts differentiation and inhibits osteoclasts formation
- Osteoclasts inhibition is mediated by integrin β1/FAKpY397/MAPK pathway
- Macrophages cytokines and clastokines are induced to osteogenic favorable

Interface Chemistry on MXene-Based Materials for Enhanced Energy Storage

Hanmei Jiang
School of Metallurgy and Materials Engineering, Chongqing University of Science and Technology, China

- MXene-based heterojunction composites with strong synergistic effect can be constructed by in situ synthesis strategy.
- The dominant pseudocapacitive contribution for the MXene-based heterojunction composites can be tuned by adjusting the MXene loading.
- Oxygenated group and defect enriched MXene synthesized by chemical etching for high gravimetric capacitance supercapacitor
Development of Simulation Method for High-Speed AFM Images and Protein Structural Dynamics
Yui Kanaoka
Graduate School of Science, Nagoya University, Japan

- Pseudo-AFM: Reconstructing fast AFM images from structural information.
- Open conformation in HS-AFM of P-glycoprotein (P-gp) doesn’t correspond with known structure.
- Normal Mode Analysis (NMA) was applied to reconstruct dynamic open structure observed at HS-AFM.
- We discuss about the method of reconstructing AFM image by simulation.

(A) Simulated AFM image generation
(B) P-gp observed image by HS-AFM
(C) NMA for reconstruction
(D) Simulated AFM image
Technical Special Session 17
Functional Materials for Terahertz Manipulation

Room 3
14:00-16:00 Wednesday, 2 August
Chair: Wanxia Huang
Co-Chair: Qiwu Shi

17-1  14:00–14:20

Reconfigurable and nonvolatile terahertz devices based on phase change films
Zhen Tian
School of Precision Instrument and Optoelectronics Engineering, Tianjin University, China

- Terahertz nonvolatile rewritable encryption memory;
- Terahertz wave modulators based on a phase-change material;
- Reconfigurable terahertz lithography-free photonic devices;
- Reconfigurable terahertz on-chip metalens

Design principle of the nonvolatile-reconfigurable THz on-chip metalens

17-2  14:20–14:40

Nanocomposites with tunable refractive index for active all-dielectric terahertz metamaterials
Tianlong Wen*, Junxiao Liu, Qiye Wen*
School of Electronic Science and Engineering, University of Electronic Science and Technology of China, Chengdu 611731
e-mail: halong@uestc.edu.cn, qywen@uestc.edu.cn

- Nanocomposites with tunable refractive index were prepared by using gold and strontium titanate nanoparticle as fillers.
- Using the nanocomposites, tunable all-dielectric metasurface can be made to manipulate the propagating terahertz wave.
- Optically tunable terahertz absorbers and polarization converters were successfully achieved by the metasurfaces prepared by this nanocomposites.

Optically tunable all-dielectric terahertz metasurface

17-3  14:40–15:00

Preparation of VO₂ Thin Films for Tunable Terahertz Devices
Dongping Zhang
Shenzhen Key Laboratory of Advanced Thin Films & Applications
Shenzhen University, China

- High performance VO₂ thin films were prepared by pulsed DC magnetron sputtering method.
- VO₂-based tunable Terahertz devices with wheel and square shape Au unit cell were designed and fabricated respectively.
- Wheel shape device offers a 70% modulation depth at 0.56 THz.
- For square shape device, 91.5% modulation depth and ~2ps ultra fast response speed at 0.87THz under optical pumping were obtained.

The schematic diagram of (left) structure and (right) a unit cell of designed metamaterial modulator.
Fundamental design of VO₂ film and interface for high-efficient THz modulation

Qiwu Shi
College of Materials Science and Engineering, Sichuan University, China

- The design of polycrystalline VO₂ film with around 90% THz transmission modulation was proposed.
- The impedance matching method based on VO₂ interface was investigated to realize near 100% THz reflection modulation.
- An interfacial design using MXene layer in VO₂ film was developed for lower-power phase transition threshold.
- This work would provide significant insights for high-performance VO₂ based THz smart devices.

Broadband polarized terahertz modulation using graphene based metasurface

Kun Meng
Qingdao Quenda Terahertz Technologies, Ltd., China

- Tunable broadband terahertz polarizer using graphene based metasurface were designed and fabricated.
- High performance THz-TDS equipment was produced.
- Properties of the polarizers were measured and analysed.
Phase-field model of electric-field-induced crystalline phase transition mechanism for improving the efficiency of electrocaloric effects
Houbing Huang
Beijing Institute of Technology, China

- Electrocaloric cooling of ferroelectric materials provides a new way for energy-saving refrigeration due to high efficiency, and small size, thus it has important applications in the field of refrigeration of electric devices such as chips. The traditional methods increase the entropy change of the electrocaloric effect by increasing the applied high electric field, but it can lead to the breakdown of the materials. Therefore it is urgent to find a new way to improve the entropy change of the electrocaloric effect. The research object of this project is the electrocaloric effect in ferroelectric polymers, using an applied low electric field to achieve reversible regulation of the crystallinity of ferroelectric polymers and increasing the entropy change by increasing the crystallinity of ferroelectric polymers, to achieve high entropy change under low electric fields. Firstly, the crystalline phase transition of materials is coupled with the electric field based on the traditional phase-field model, and a new phase-field model is developed to explore the theoretical law of "crystallinity-polarization coupling". Secondly, the phase-interface-polarization intensity coupling is effectively controlled by the precise design of the microstructure, and the microscopic mechanism of electric-field-induced crystallization is revealed. Finally, the electric-field-driven crystallinity can improve the entropy change and temperature change of the electrocaloric effect, greatly improve the refrigeration efficiency of the electrocaloric cooling, and provide a feasible design scheme for the further development of high-performance ferroelectric refrigeration materials.

Multiple Polarization States in van der Waals Layered Ferroelectrics
Fucai Liu
School of Optoelectronic Science and Engineering, University of Electronic Science and Technology of China, China

- van der Waals Layered materials provide a novel platform for studying ultrathin ferroelectricity
- Ferroelectric-ionic coupling induced multiple polarization states in layered CuInP$_2$S$_3$
- layered dependent multiple polarization states of sliding ferroelectricity in rhombohedral-stacked MoS$_2$

Large Piezoelectric Responses in Lead-Free Ferroelectric Crossover around MPB
Le Zhang
School of Physics, Xi'an Jiaotong University, China

- This work proposed a new strategy to largely boost up the static/dynamic piezoelectric properties of lead-free ferroelectrics through building the ferroelectric crossover near the morphotropic phase boundary (MPB) region. A large reversible electrostrain ($S_{r_{max}}$) of 0.55% under a low electric field was obtained at the constructed relaxor/MPB crossover in (Ba$_{0.6}$Na$_{0.4}$)$_2$TiO$_3$-based lead-free piezoelectrics. Furthermore, the static piezoelectric responses $d_{33}$ of BaTiO$_3$-based ceramics have been boosted up to ~ 610 pC/N by using the crossover concept at MPB. The strategy of constructing ferroelectric crossover near MPB provides a new route for improving the electromechanical output of lead-free ferroelectrics.
High-entropy perovskite ferroelectrics
He Qi, Jun Chen
University of Science and Technology Beijing
qiheustb@ustb.edu.cn

- Multiple novel local polarization configurations have been designed in high-entropy ferroelectrics.
- Significantly improved electrical properties can be achieved with the introduction of high-entropy strategy in ferroelectrics.
- Mechanism for generating excellent physical properties in high-entropy ferroelectrics was discussed in detail.

Characterization and Performance Regulation of Metal Oxide Thin Films at the Atomic Scale
Ming Wu, Zheng Wen, Xiaojie Lou, S. J. Pennycook
Xi’an Jiaotong University, Qingdao University, National University of Singapore

- A flexoelectric photodetector based on a thin-film heterostructure is proposed.
- A giant strain gradient of the order of 10^6/m is achieved in LaFeO_3 thin films, giving rise to an obvious flexoelectric polarization and generating a significant photovoltaic effect.
- This work not only demonstrates a novel self-powered photodetector different from the traditional interface-type structures, such as the p-n and Schottky junctions but also opens an avenue to design practical flexoelectric devices for nanoelectronics applications.

Application-oriented Modulation of Lead-free Energy-storage Relaxor Ferroelectric Ceramics for High-density Power Converters
Longwen Wu
College of Electrical Engineering, Sichuan University, China

- 0.87BaTiO_3-0.13Bi[(Zr_{0.2}Ti_{0.8})_{1/3}(Sn_{0.85}Ta_{0.15})_{1/3}]O_3 (BTBZNT) lead-free energy-storage relaxor ferroelectric ceramics were modulated with CaZrO_3 (CZ) for application orientations
- Optimal CZ content from application-oriented evaluation is opposite to that from community adopted method
- Energy-storage performance was maximized at DC-biased electric field and high temperature
Grain dependence of domain feature was observed in BF-BT relaxor ferroelectrics. Properties including piezoelectricity, electrostrain and resistivity can be well regulated by domain engineering. The structural origin and physical mechanism were explored.
Technical Special Session 19
Micro/Nano Fabrication and Integrated System (ss)
Room 5
14:00-16:00 Wednesday, 2 August
Chair: Liang He
Co-Chair: Ruping Liu

19-1 14:00–14:20

**Atomistic Simulations of 3D Micro/nanostructures Fabrication by Micromachining Techniques**

Zai-Fa Zhou  
Key Laboratory of MEMS of Ministry of Education, Southeast University, China

- This talk will present atomistic modeling and simulations of 3D Micro/nanostructure fabrication.
- The limitations and advantages of different modeling approaches and simulation algorithms are analyzed and discussed.
- Micro/Nanostructures by different micromachining techniques are simulated and compared with experimental results.
- The results will benefit the MEMS/NEMS fabrication optimization and high yield device design.

19-2 14:20–14:40

**Multiplexed Flexible Optical Chemical Sensors for Point-of-Care Diagnosis and Dynamic Monitoring**  
Nan Jiang  
West China School of Basic Medical Sciences & Forensic Medicine, Sichuan University, China

- We have developed a series of wearable and implantable optical chemical sensors.
- These multiplexed flexible sensors exhibit high biocompatibility and improved sensing efficiency in biological tissues.
- The sensors can also achieve continuous dynamic monitoring of biomarkers in body fluids.
- The flexible optical chemical biosensors facilitate point-of-care diagnosis and dynamic monitoring of complicated diseases.

19-3 14:40–15:00

**Flexible Tactile and Proximity Sensors for Robotic Manipulation**  
Yonggang Jiang*, Yudong Cao, Jiacheng Li  
School of Mechanical Engineering and Automation, Beihang University, China

- Endowing robots with multi-directional tactile sensing capabilities has long been a challenging task in the field of flexible electronics and intelligent robots. We present a highly sensitive flexible tactile sensor with an embedded-hair-in-elastomer (EHE) structure.
- Inspired by near-field sensing functions of electric fish, we developed flexible tactile and proximity sensors for robotic manipulation, which have object recognition capability.
Stretchable conductors with high performance for soft electronic devices

Jiangxin Wang
School of Mechanical Engineering, Sichuan University, China

Abstract: Soft and stretchable electronics are emerging as a new type of devices with their exceeding mechanical compliance properties. They are essential technologies for the next-generation smart, active, and user-interactive electronic systems that cannot be addressed with conventional devices. Stretchable conductors are vital and indispensable components in soft electronic systems. By utilizing the dynamic and robust electrical anchors provided by Eutectic Gallium Indium Microparticles (EGaInPs), we can achieve superelastic conductors with high conductivity and excellent cycling durability under stretching. The elastic conductors can also be fabricated into one-dimensional structures, enabling stretchable conductive fibers for different electronic textile applications, including physiological monitoring, neuromuscular electrical stimulation, and energy harvesting etc.

Vortex-induced vibration triboelectric nanogenerator for energy harvesting from low-frequency water flow

Biao WANG
School of Future Technology, Shanghai University, China

• A VIV-TENG is proposed for harvesting low-frequency hydrokinetic energy from low-speed water.
• The vortex is aroused by the cylinder and amplified by the cantilever.
• A modified VIV model and a CFD model are built to study the dynamic characteristics of the device.
• The maximum output voltage of 174 V and the maximum power output of 2.5 mW are achieved.

Correspondence to: (biaowang6@shu.edu.cn)
Technical Special Session 20
Advanced Optical Manufacturing and Detection (ss)
Room 6
14:00-16:00 Wednesday, 2 August
Chair: Chunyang Wang
Co-Chair: Bo Xiao

20-1  14:00–14:20

Multi-robot collaborative polishing of large aperture aspheric mirror
Yongsheng Yao
Xi’an Institute of Optics and Precision Mechanics of CAS, China

- Study on efficiency and stability of tool influence function of polishing wheel
- Nonlinear modeling between polishing wheel speed and removal efficiency
- Multi-robot collaborative polishing technology based on dwell speed algorithm
- Application of wheel polishing technology in high precision aspheric surface machining

20-2  14:20–14:40

Research on High Precision Magnetorheological Polishing Technology of Optical Elements
Jing Hou
Laser Fusion Research Center of China Academy of Engineering Physics, China

- Presents high-precision magnetorheological polishing machine and the technology of optical component processing
- Achieved full-band nanoscale processing indexes for meter-scale planar optical components and aspherical optical components
- Presents the application of magnetorheological processing techniques in the detection of subsurface defects in single-crystal silicon components using X-rays

20-3  14:40–15:00

Ultra High Precision Deterministic Machining Technology Of Full Frequency Band Error
Wenhui Deng
Laser Fusion Research Center of China Academy of Engineering Physics, China

- Developing a technology that combines high-precision numerical control shaping and ultra-high precision ion beam correction for large optical systems.
- Achievement of ultra-high precision manufacturing of optical elements with PV accuracy < λ/100 and RMS accuracy < 1 nm.
- Coordinating convergence of mid-to-high-frequency and low-frequency errors, enabling high-precision deterministic correction of Full Frequency Band Errors
### 20-4 15:00–15:20

**A Novel High-resolution Confocal Microscopy Imaging Technique Based on Bifocal Lenses**
Xueliang Zhu, Tian Wang, Jiayu Ru
Optical Engineering, Xi’an Technological University, China

- A bifocal interferometric confocal microscope system (BICMS) based on bifocal lenses is proposed.
- The full width at half maximum for the normalized lateral point spread function is reduced.
- BICMS overcome the tradeoff between high resolution and long working distance.
- The proposed system represents a significant contribution to super-resolution confocal microscopy imaging.

### 20-5 15:20–15:40

**Research on the distribution of the circulation of double-sided polishing method based on processing forecast modeling**
Xuelian Liu
School of Defence Science and Technology, Xi’an Technological University, China

- Construct a machining prediction model based on the motion principle and pressure distribution principle of the ring pendulum double-sided polishing equipment.
- It can be found that an upper polishing disc with a larger radius than the desired ring area can be selected based on the position of the component surface to be processed.
- Based on this law, guiding practical processing by copper the surface profile of optical components from $2.27 \lambda$ ($\lambda=632.8\text{nm}$) reduced to 1.85 $\lambda$.
Study of protein-protein interactions by AFM-based force spectroscopy

Peng Zheng
School of chemistry and chemical engineering, Nanjing University, China

Atomic force microscopy (AFM)-based force spectroscopy is a powerful tool to study protein stability, protein-protein interaction and protein-membrane interaction.

High-Resolution Imaging of nc-AFM and Its Application in Catalysis

Mengxi Liu
National Center for Nanoscience and Technology, China

- nc-AFM has emerged as a powerful tool for the real-space imaging of single molecules, achieving submolecular resolution.
- Non-hexagonal carbon rings and diyne moieties have been constructed within the honeycomb lattice of graphene.
- These topological structures exhibit unique characteristics, enabling the modulation of graphene's band structure.

High-speed AFM in biomolecular application

Fang Jiao
Laboratory of Soft Matter Physics, Institute of Physics, CAS

- HS-AFM shows high spatial- and time-resolution (Spatial resolution: 1nm in XY direction, 0.1 nm in Z direction; Imaging speed: 50ms/frame)
- Real-time real-space tracking biomolecular structural information
- PFN2 protein shows clock-wise hand-over-hand pre-pore to pore transition
Investigation of Cell Response by Atomic Force Microscopy
Dan Xia
School of Materials Science and Technology, Hebei University of Technology, Tianjin, China
• The morphology and mechanical properties of normal and pancreatic cancer cells were studied by AFM.
• The NIR activated SNSs have been identified as an effective nontoxic photothermal conversion agent for irreversibly disassembly of the Aβ40-42 aggregates.
• The therapeutic effect of Cur as an anti-AD drug in cell mechanics were explored by AFM.
• The mechanism of Cur's inhibition of Aβ-induced cell damage was explored by AFM.

Investigation of interfacial water micro-nanostructures by atomic force microscopy
Qiang Li
School of Chemistry and Chemical Engineering, Shandong University, China
• Ice-like water adlayer up to three layers confined between graphene and mica substrate were observed.
• Ice-like water adlayer at mica surface was directly constructed and investigated.
• The hydration structures at the solid–liquid interface were successfully visualized at the atomic scale.

Quantitative Nanofriction of 2D Phosphorus Materials
Yuge Zhang
Interdisciplinary Nanoscience Center, Aarhus University, Denmark
• Nanotribology Tool – Friction Force Microscopy
High-resolution Imaging -> Crystal Struture
• Atomic Stick-slip Motion -> Energy Dissipation
• Angle-dependent Friction -> Relationship between Crystal Structure and Friction
• Coefficient of Friction -> Lubricative Performance
Ag₂Se-based Thermoelectric materials and their potential application in broadband photodetection
Lei Yang
Materials Science and Engineering, Sichuan University, China

• Understanding the origin of thermoelectric Ag₂Se;
• Optimizing the thermoelectric and mechanical properties of Ag₂Se via structural and grain boundary engineering;
• Preparing Ag₂Se films via a room temperature process;
• Achieving broadband photodetection based on the photo-thermal response of Ag₂Se films.

Optimizing output performance and parasitic depletion of Bi₂Te₃ TEGs by a high-density approach
Guangkun Ren
Institute of Materials, China Academy of Engineering Physics, P. R. China

• The fabrication processes manipulate electrode deposition and reflow soldering techniques of delivering micro- and bulk-TEG;
• A normalized power density of ~ 13.7 μW cm⁻² K⁻² at ΔT of 13 K, has been achieved.
• The finite-element simulation data indicate that it could further be ~ 25.4 μW cm⁻² K⁻².
• Optimizing packing fraction by increasing the quantity of thermocouples, could be an effective avenue.

Novel Meta-phase Arising from Large Atomic Size Mismatch
Kunpeng Zhao
Shanghai Jiao Tong University, China

• Discovering a novel phase of matter - meta-phase despite large atomic size mismatch.
• Exquisite atomic structure with contrasting degree of ordered/disordered sublattice.
• Unusual physicochemical properties that are hard to attain in conventional phases.
• The concept of meta-phase will usher in more innovations in materials research and technical applications.
Thermoelectric properties of pyrite-type dichalcogenides
Yongsheng Zhang
Advanced Research Institute of Multidisciplinary Sciences,
Qufu Normal University, China

- Effects of the rattling-like metal atoms and the localized nonmetallic dimers on the thermal transport properties.
- Complex energy isosurfaces allowing for large density-of-states and small conductivity effective masses for p/n-type carriers.
- Promising thermometric properties of the pyrite-type compounds with ZT > 1.5.

YZ is the corresponding author of the papers

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High thermoelectric properties of p-BiSbTe through SLM 3D printing
Jun Tang
Institute of Nuclear Science and Technology &
College of Physics, Sichuan University, Chengdu, China

- Bi$_2$Te$_3$-based materials were successfully prepared using selective laser melting 3D-printing.
- SLM printed materials display isotropic thermoelectric properties.
- A peak ZT$_{max}$ of 1.31 and an average ZT$_{ave}$ of 1.13 were obtained for p-BiSbTe materials.
- This work provides a promising engineering to achieve high-performance TE by selective laser melting 3D-printing

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Formation Mechanism and Enhanced Thermoelectric Performance of Icosahedral Cu$_5$FeS$_4$ with High-Density Twin Boundaries
Guang Han
College of Materials Science and Engineering, Chongqing University, China

- Cu$_5$FeS$_4$ core-shell icosahedral nanoparticles with high-density twin boundaries were synthesized by a colloidal method.
- The density of twin boundaries are tuned by modifying the Cu/Fe ratio of the precursors.
- Fe plays an important role in the formation of Cu$_5$FeS$_4$ core-shell icosahedral nanoparticles.
- The ZT values of Cu$_5$FeS$_4$-based materials are improved by introducing high-density twin boundaries.
Manipulation of zinc oxide nanowires (NWs) for bionanosensors design

The experiments on 3D nanomanipulation of ZnO NWs are reported for the development of the technology of bionanosensors in configuration of field-effect transistors (NanoFETs).

The size of the NWs was in the range 10-300 nm in thickness and 1-50 µm in length.

Aleksei Prokunin, Vladimir Shavrov, Victor Koledov, Peter Loga, Andrey Orlov, Svetlana von Gratowski
Kotelnikov Institute of Radiotechnics and Electronics of the Russian Academy of Sciences
Moscow, Russian Federation
Artem Irzhak, Evstaf’eva Maria
Institute of Microelectronics Technology and High-Purity Materials of Russian Academy of Sciences
Chelyabinsk, Russian Federation
Ngo Thi Hong Le, Vu Hong Ky, Ta Nguyen Bach, Phuong Thi Thu
Institute of Materials Science, Vietnam Academy of Science and Technology, Hanoi, Vietnam

Treatment of Carbon Nanotube Thread in a Microwave Magnetic Field

Carbon nanotube (CNT) threads are well suited for microwave treatment in cavity resonators.

CNT threads with a residual Fe catalyst are paramagnetic at a frequency of 2.45 GHz.

The interaction of high-power microwave radiation (up to 1.3 kW) with CNTs strongly depends on the field distribution.

Didar Kurzhumbaev, Sergey Urvanov, Aida Karaeva, Eduard Mitberg, Nikita Kazennov, Victor Koledov
1MIPT, 2TISNCM, 3IRE RAS, Russia

Influence of crystallization conditions on local atomic structure of austenite in rapidly quenched TiNiCu shape memory alloys

Local crystalline environment of Ni and Cu atoms in TiNiCu containing 30 and 40 at.% Cu has been studied by EXAFS spectroscopy.

Electropulse crystallization has a more noticeable effect on the local atomic structure of austenite compared to martensite.

Local disorder of atoms in the Cu coordination shells and lengths of Cu-Ni and Cu-Cu bonds decrease, hinders an increase in the lattice parameter of the austenite phase and stabilizes its crystal structure.

Alexander Shelyakov, Olga Chernysheva, Kirill Borodako, Nikolay Sitrinov, Alexey Seregin
National Research Nuclear University MEPhI, Moscow, Russian Federation
Alexey Veligzhnin
National Research Centre "Kurchatov Institute", Moscow, Russian Federation

Technical Special Session 23
Functional Nanomaterials for Microelectronics and Biotechnology (ss)
Room 9 Poster
Wednesday, 2 August
Chair: Artem Irzhak
Co-Chair: Victor Koledov

23-1
Manipulation of zinc oxide nanowires (NWs) for bionanosensors design

23-2
Treatment of Carbon Nanotube Thread in a Microwave Magnetic Field

23-3
Influence of crystallization conditions on local atomic structure of austenite in rapidly quenched TiNiCu shape memory alloys
Technology for obtaining membranes based on porous silicon

N.V. Alexandrov¹, E.A. Gosteva¹, V.V. Starkov²
¹JUST MISIS, Russia
²IMT RAS, Russia

• The technology allows to create membranes, which can be used in various filtering devices
• Such characteristics as the porous layer depth and the pore diameter can be varied
• Preliminary electrochemical etching and subsequent mechanical processing are used for obtaining membranes

The work was supported by the Russian Science Foundation within the framework of project 22-19-00783.

Fundamentals of creating biosensors based on nanowires by mechanical assembly methods

Peter Lega
RUDN University, Engineering Academy, Moscow, Russia
Kotelnikov Institute of Radioengineering and electronics of RAS

• Transistors with a controlled channel were fabricated from a single CNT.
• Work on the fabrication of test structures was carried out in the chamber of an electron microscope using 3D nanomanipulators and nanotools manufactured for this purpose.
• On the equipment for cryogenic measurements, measurements of the electrophysical properties of the single CNT was carried out.
On-chip Infrared Circular Polarization Detector with Ultrahigh Discrimination

- Chiral metamaterial integrated hot-electron infrared detector
- Configurable circular-polarization-dependent optoelectronic silent state based on in-detector photocurrent differential operation
- Near-infinite circular polarization extinction ratio
- Ultralow noise equivalent light ellipticity difference of 0.009° Hz⁻¹/²

LinesBroken mirror symmetry tuned topological transport in PbTe/SnTe heterostructure

- By constructing PbTe/SnTe heterostructures, we discover giant linear magnetoresistance (GLMR)
- Strong metallic behavior that are likely induced by Dirac fermions with a high carrier mobility is found
- By decreasing the hole density in SnTe, a much weaker metallic are exhibited
- The revelation of lattice structural distortion and mirror symmetry breaking in heterostructure transport properties is novelty

Large-area synthesis of 2D metal chalcogenides for optoelectronic image sensors

- This report introduces a large-area growth strategy of 2D metal chalcogenides based on induced chemical vapor deposition, and the development of optoelectronic integrated device construction and image sensor studies.
- We have achieved the large-area controllable growth of a series of 2D metal chalcogenides, understood their key growth mechanisms, and advanced the application of 2D metal chalcogenides in future functional devices such as optoelectronic image sensors.
**Technical Special Session 24**

**2D Materials at Nanoscale: from Fundamentals to Applications (ss)**

Room 1

16:20–18:20 Wednesday, 2 August

Chair: Zegao Wang

Co-Chair: He Tian

### 24-4 17:20–17:40

**Multiscale Modulating Charge Transport Mechanism in Organic Semiconductors**

Deyang Ji

Institute of Molecular Aggregation Science, Tianjin University, China

- Modulating charge transport from thermally activated to “Band-Like” through interfacial bottom-up binding capability of bilayer polymer dielectrics (Adv. Funct. Mater. 2023, 33, 2211742)
- Modulating charge transport from thermally activated to “Band-Like” by changing the position of alkylation in organic semiconductors (ACS Appl. Mater. Interfaces 2023, 15, 16930)

### 24-5 17:40–18:00

**2D Materials Infrared Photodetector Enhanced by Surface Plasmon Polaritons**

A.P., Wen Huang¹ and A.P., Junxiong Guo¹,²

1. School of Integrated Circuit Science and Technology, University of Electronic Science and Technology of China, China
2. Institute of Advanced Study, Chengdu University, China

E-mails: uestchw@uestc.edu.cn; guojunxiong@cdu.edu.cn

- Novel conceptual design for 2D materials based infrared photodetector
- Ferroelectric superdomain controlled graphene plasmons for tunable mid-infrared detection
- Localized surface plasmon of metal nanoparticles enhanced infrared photodetection in 2D materials

### 24-6 18:00–18:20

**Resistive Switching Effect in 2D-Material Based Memristors**

Feng Xiong

College of Advanced Interdisciplinary Studies, National University of Defense Technology, China

Nanhu Laser Laboratory, National University of Defense Technology, China

Resistive switching (RS), a nonlinear electric property shown by some configurations, has the potential application in on-chip electronics. Here we investigated RS effect in both Ag/SlO/graphene, LDH, 1T-TaS to explore their applications in modern electronics.

- Graphene local sensor was used to investigate RS effect in Ag/SlO structure.
- New memristors based on LDH/graphene heterojunctions.
- A thermal gate transistor has been invented based on RS effect in TaS.
Conductive nanostructures in a filamentous bacterium for long-distance electron transfer
Yonggang Yang
School of Life Science and Engineering, Foshan University, China

- The filamentous Gram-positive bacterium Lysinibacillus varians GY32 generates wire and tube-shape nanostructures.
- The nanowires are protein polymer and nanotubes are membrane extensions.
- Both the nanowires and nanotubes are conductive.
- These conductive nanostructures may mediate long-distance or intercellular electron transfer.

Heterogeneous Photocatalysis for Synthetic Chemistry
Ren Su
Dept. Energy, Soochow University, China

- Understanding photocatalyzed reactions by surface science and in-situ spectroscopy.
- Precise design of heterogeneous photocatalyst materials.
- Precise synthesis of value-added chemicals by heterogeneous photocatalysts.
- Design of modular tubular systems for large scale applications.

Iron(II) oxalate self-assembling nanorods for energy and medical applications
Shifei Kang
Institute of Photochemistry and Photofunctional Materials (IPPM), University of Shanghai for Science and Technology, China

- Iron(II) oxalate nanorods with different morphologies, was obtained by precipitation at room temperature.
- Hollow quadrangular Iron(II) oxalate nanorods coupled with lignin fibers form high-quality photo-Fenton water treatment membrane.
- Iron(II) oxalate nanorods stimulated free radical reaction under physiological level H2O2 to promote nerve repair in vivo.
- By regulating the dehydration of oxalic acid hydrates, its stability in lithium-sulfur-batteries was improved.
Identifying Hetero-zipper β-Sheet in Twisted Amyloid Aggregation

Yongxiu Song\textsuperscript{1,2,4}, Lei Liu\textsuperscript{2,*}, Kaituo Wang\textsuperscript{3,*}, Mingdong Dong\textsuperscript{4,*} et al

\textsuperscript{1} Ningbo institute of Dalian University of Technology, China
\textsuperscript{2} Institute for Advanced Materials, Jiangsu University, China
\textsuperscript{3} Department of Biomedical Sciences, University of Copenhagen, Denmark
\textsuperscript{4} Interdisciplinary Nanoscience Center (NANOS), Aarhus University, Denmark

- Hetero-zipper β-sheets in amyloid peptide protofilament by Cryo-EM with a high resolution of 3.5 Å
- Each peptide zippers were arranged by an alternative manner
- Assembled twisted and supra-twisted fibrils were identified with retentive periodicity
- It updates the pathway guiding peptide super-assembling and folding, different from works previously reported

Fig1 Amyloid peptide self-assembled into the hetero-zippers within β-Sheets.

Notes:

Hierarchy evolution of protein assembly at solid-liquid interfaces for bio-composite synthesis

Shuai Zhang

Materials Science and Engineering, University of Washington, USA

- The assembly dynamics of protein assembly at solid-liquid interfaces are in-situ observed.
- Entropic force between protein molecules and the designed protein-substrate interactions determine the assembly outcomes.
- Colloidal forces are essential for rational design of protein-mineral interfaces but challenging to modulate.

Interfacial Chemistry Effects in the Electrochemical Performance of Silicon Electrodes under Lithium-Ion Battery Conditions

Xiangdong Xu

Department of Chemistry, University of Warwick, United Kingdom

- The impact of SiO\textsubscript{x} layer on solid-electrolyte interphase formation and (de)lithiation performance
- Correlative electrochemical multi-microscopy combining scanning electrochemical cell microscopy and secondary ion mass spectrometry (SECCM/SIMS)
- SiO\textsubscript{x} improves lithium reversibility and spatial uniformity in electrochemical response, SEI properties and chemistry than HF-Si
- SECCM opens new avenue to deeply understand battery materials in nano- and macroscale
Perspective at Circular Single Stranded DNA
Jie Song
Shanghai Jiao Tong University

- The study of synthetic gene circuits is one of the cutting-edge research in the cross integration of biology and information technology.
- Based on cyclic single stranded DNA (CssDNA) and DNA origami technology, information transmission and encrypted information storage of variable DNA structures were achieved, and controllable operations and molecular communication based on variable DNA structures were explored.
- Next our team has found that CssDNA can also serve as a gene expression vector and can be efficiently expressed in various cell lines and can be applied in cutting-edge fields such as diagnosis, treatment, biological computing, and brain-like intelligence.
**Broadband Terahertz modulation with two-dimensional carbides and nitrides (MXenes)**

Tao Zhao
School of Physics, University of Electronic Science and Technology of China, China

- MXene thin film has strong response to broadband terahertz waves with low dispersion.
- MXene thin film can approach the thin-film absorption limit in 0.5-10 THz band.
- MXene thin film is a promising candidate for broadband and uniform terahertz modulation.

**Metamaterials-based Artificial Optical Nonlinearity and Its Terahertz Applications**

Yongzheng Wen
School of Materials Science and Engineering, Tsinghua University, China

- Artificial optical nonlinearity based on magnetoelectric coupling process in the metamaterial structure.
- The artificial nonlinearity can realize nonlinear responses without involving natural nonlinear materials.
- We achieve terahertz second harmonic generation at room temperature with silicon-based metamaterials.
- This novel mechanism may bring fantastic potential to terahertz sources.

**Ultrafast Spectroscopy and Optoelectronic THz Devices of 1D Nanomaterials**

Maria Burdanova
Center for Photonics and 2D materials, Moscow Institute of Physics and Technology, Russia

- Strong many-body interactions led to formation of stable excitons and trions in 1D nanomaterials.
- Terahertz (THz) radiation provides a non-contact probe of the local motion of charges in nanomaterials and nanocomposites, which has been exploited to explore the plasmonic nature of charge transport in nanotubes' thin films.
- The interaction of trions, excitons and equilibrium charge carriers was understood and result in development of THz modulators.
- The stretchable films of nanotubes have been used to control the main characteristics of the desired THz elements.
Multi-scale artificial design of infrared emitter with functional materials

Jun Wang
Air Force Engineering University, P R China

• 1. Infrared emitters fabricated with VO$_2$, high-entropy alloy, or ITO, etc.
• 2. A thermally robust and optically transparent infrared selective emitter.
• 3. Design of scene-adaptive infrared camouflage emitter with VO$_2$-based multilayer and metamaterial.
• 4. High temperature infrared-radar compatible stealthy metamaterial based on an ultrathin high-entropy alloy.

Low Dielectric Air Material via CO$_2$ Foaming for High-Frequency Electromagnetic Wave Transmission

Pengjian Gong and Guangxian Li
College of Polymer Science and Engineering, Sichuan University, People’s Republic of China

• Air has the lowest $\varepsilon$ and $\sigma$, Air Material is the tendency for high frequency signal transmission
• Non-residual supercritical CO$_2$ foaming introduces large amount of low THz loss air in polymer matrix
• Micro-scale bubble and nano-scale matrix contribute the high signal transmission
Positive and negative electrocaloric effect in the direct and indirect characterization of NaNbO₃-based ceramics with tetragonal–cubic phase boundary

Hong Tao
Sichuan Prov Key Lab Informat Mat, Southwest Minzu University, China

• Tetragonal-cubic phase boundary in the NN-based ceramics with reduced Tₐ and increased relaxor characteristic.
• A novel phenomenon of negative ΔT and ΔT/ΔE for indirect characterization around Tₐ multiphase coexistence.
• Contribution of the long-rang order matrix with a certain amount of PNRs to negative ECE

Deciphering the phase transition-induced ultrahigh piezoresponse in (K,Na)NbO₃-based piezoceramics

Bo Wu
Physics department, Southwest Minzu University, China

• Electric field-induced phase transition between orthorhombic and tetragonal phases triggers dramatic volume change.
• Huge effective piezoelectric coefficient of 1250 pm/V is contributed by the dramatic volume change.
• The principle of electric field-induced phase transition provides broader design flexibility in piezoelectric materials.

High-Efficiency Reactive Oxygen Species Generation by Piezocatalysis in Perovskite

Yanli Huang, Boyan Lv, Jiagang Wu,* and Xianzeng Zhang*
College of photonic and electronic engineering, Fujian Normal University, China

• The synergy of multiphase coexistence and local TiO₆ octahedral distortion is employed to trigger large piezopotential and easier charge separation in BT-based piezocatalysts
• High-efficiency generation rates of •OH and •O₂− are obtained in BCTZ, by piezocatalysis, which is 3.5 times more than that of pure BT
Grain size effect on electrocaloric performance in barium titanate-based ferroelectric ceramics

Chunlin Zhao, Hong Li, Xiao Wu, Min Gao, Tengfei Lin, Cong Lin
College of Materials Science and Engineering, Fuzhou University, Fuzhou

- Discontinuous grain growth and relevant grain size effect on electrocaloric performance are investigated.
- Electrocaloric strength of fine- and large-grain ceramics exhibits opposite changing tendency with electric field.
- Different grain-boundary-inhibition effect on polarization rotation contributes this phenomenon.
- C. Zhao managed this project, and all the authors contribute to the discussions.

Deciphering the role of A-site ions of AZrO$_3$-type dopants in (K, Na)NbO$_3$ ceramics

Xiang Lv
College of Materials Science and Engineering, Sichuan University, Chengdu 610065, China

- Studying the effects of different AZrO$_3$-type additives on KNN ceramics from multi-scale perspectives.
- The large off-center displacement of Bi$^{3+}$ effectively reduces $T_{C1}$.
- The displacement of Bi$^{3+}$ originates from small ionic radius and high covalency of Bi-O bonds.

Piezoelectric Ultrasound Energy Transfer for Wireless Powering Implant

Laiming Jiang
College of Materials Science and Engineering, Sichuan University, China

- A hybrid-induced energy transfer strategy using photoacoustic and piezo-ultrasound for wireless-powering implants was proposed.
- Flexible design with a bio-inspired 3D twining linear array was adopted.
- Strategic material integration of a new (K,Na)NbO$_3$-based lead-free micro-composites in the device was implemented.
Enhanced piezoelectricity and non-contact optical temperature sensing performance in Rare-earth element modified (K, Na)NbO$_3$-based multifunctional ceramics

Qing Liu
School of Optoelectronic Science and Engineering, University of Electronic Science and Technology of China, China

- Novel rare earth ion modified potassium-sodium niobate based ceramics were elaborately designed and prepared
- A considerable $d_{33}$ of exceeding 300 pC/N and a large $d_{33}^{*}$ up to 500 pm/V
- Non-contact optical temperature sensing with a maximum $S_r$ of 16.7% K$^{-1}$
- Both decent electrical properties and intriguing photoluminescence performance for the future multifunctional optoelectronic devices
Research on Glucose Sensor Based on Prussian Blue Composite Membrane Modified Electrode

- The micro three-electrode sensing chip was prepared by vacuum evaporation of gold and silver on silicon substrate by designing mask version. With Au electrode as the working electrode and counter electrode and Ag/AgCl electrode as the reference electrode, and the constructed Nafion/GOx/GNFs/PBNPs/PEDOT/Au@Si glucose sensor has good electrocatalytic performance for glucose.
- It has excellent stability, reproducibility and selectivity. It can be applied to the field of wearable sensors in the future.

Design and Control of an Analog Optical Switch Based on the Coupling of an Electrothermal Actuator and a Mass–Spring System

- An analog optical switch based on an electrothermal actuator and a mass–spring system is designed.
- A multibody electro-thermal–mechanical model is developed to explain the dynamic mechanism of the coupling device.
- A feedback control scheme is proposed to realize analog output function and improve anti-interference performance.

Coupled thermoelastic nonlocal forced vibration of an axially moving micro/nano-beam

- Coupled thermoelastic vibration of an axially moving micro/nano-beam is studied.
- Green’s functions are used to decouple the coupled system.
- Both the vibration and heat transfer equations consider the small-scale effect.
- New heat rotation phenomena are first discovered.
- Changes of the displacement and temperature have one-to-one correspondence.
Micron-scale 3D printing of a biocompatible hydrogel via phase separation

Jigang Huang
Department of Mechanical Engineering, Sichuan University, China

- Optimized photosensitive resin based on AM-AA hydrogel
- Submicron resolution by DLP 3D printing
- Multicellular co-culture in a printed hepatic lobule structure

Fiber optic-based LSPR biosensors for cancer diagnosis and therapy

Zewei Luo, Yixiang Duan
School of Mechanical Engineering, Sichuan University, Chengdu

- A Ω-shaped fiber optic LSPR with high sensitivity of refractive index for the biosensor.
- The biosensor with high sensitivity and specificity for rapid detection of proteins, small molecules, bacteria and cancer cells.
- The biosensors enable the integration with the cytosensor and therapy, showing promising potential for the clinical application
Technical Special Session 29
Manufacturing as a Service for Next Generation of Distributed Manufacturing Systems (ss)
Room 6
16:20-18:20 Wednesday, 2 August
Chair: Renxi Qiu
Co-Chair: Dayou Li

29-1 16:20–16:40

A Cloud Manufacturing Paradigm towards the Manufacturing as a Service
Renxi Qiu
School of Computer Science and Technology, University of Bedfordshire, United Kingdom

- From “distributed manufacturing” and “digital twin” to “Manufacturing as a Service” challenges and opportunities
- On-demand self-services for manufacturing and how to enable elasticity of the manufacturing processes
- Enhanced interpretability and DevOps via Platform as a Service, Containerization and Intelligent Orchestration
- Large scale parameterization using Infrastructure as a Code

29-2 16:40–17:00

Extended Reality for supporting the Smart Operator in the Manufacturing Sector
Dr. Vittorio Solina
CAL-TEK S.r.l., Italy

- Mixed Reality (MR) Application for enhancing the capabilities of the On-site Operator
- Voice and/or hands gestures interaction with the Mixed Reality Environment for better industrial performance
- Interaction between on-site and off-site operator
- Virtual Reality (VR) Application for monitoring & control by the Off-site Operator
- Interaction with the Virtual Reality part of the Digital Twin of the real environment

29-3 17:00–17:20

IEEE 3M-NANO 2023
Kandarp Amin
twi-global

- WED, 12 APRIL, 2023
- TWI Project Leaders, Kandarp Amin and Alex Russell attended the 2nd face-to-face 5G-ERA consortium meeting held at University of Calabria in Cosenza, Italy, to share the latest developments on the robotic brazing cell.
Swarm Robot SLAM with Point-Line Matching in Weak Information Environments

Jikai Guo
Institute for Research of Applicable Computing, University of Bedfordshire, UK

- Simultaneous Localization and Mapping (SLAM) is needed in weak environment information scenarios where there are only sparse and ambiguous references available, and presents significant challenges.
- This paper introduces a swarm robots based point-line matching based solution to enhance the accuracy and robustness of localization and mapping within such environments.
- Our approach employs a centralized server-based architecture for the swarm robot system and utilizes an ORB based Distributed Bag-of-Words (DBoW) algorithm to construct point and line feature dictionaries.
- By generating point-line pairs, the proposed method effectively addresses perceptual overlap issues, thereby improving the overall performance of localization and mapping for swarm robots.

Machine learning techniques for AFM-based imaging of cells

Junxi Wang
CNM, CUST, China

This paper summarizes the applications of machine learning methods in the cell image analysis by AFM. The research of the cell analysis method begins with the collection of cell data, and it emphasizes on identifying cell types, carcinogenesis or carcinogenesis levels, and its auxiliary work includes the cell segmentation, denoising, super-resolution, generation and simulation. Finally, the research experience in these analysis methods and their guiding significance for further study are discussed.

Deep Learning Based Classification for AFM Images of Cancer Cells

Yuxi Huang
International Research Centre for Nano Handling and Manufacturing of China, Changchun University of Science and Technology, China

- Atomic Force Microscopy (AFM) has been reported as an important tool for the diagnosis of both benign and malignant tumors.
- It is meaningful to use deep learning algorithms to classify cancer cells based on AFM images.
- Review the progress and research implications in the area of deep learning based classification for AFM images of cancer cells.
### 30-1 16:20–16:33

**Feedforward and Feedback Combined Control of an XYΘ-Type Micro/nano Mechanism Using Multilayer Feedforward Neural Network**  
Haitao Wu, Yunpeng Zhang and Yanding Qin  
Shenzhen Research Institute of Nankai University, Shenzhen, China, and also State Key Laboratory of Precision Electronic Manufacturing Technology and Equipment, Guangzhou, China

- A MFNN is adopted as the feedforward hysteresis compensator in the feedforward loop.
- A PID controller is adopted in the feedback loop to account for the modeling uncertainties of MFNN and the external disturbances of the system.
- The experimental results of the maximum RMSE of spiral and epicycloid trajectory is 44.0 nm and 84.4 nm, respectively.

### 30-2 16:33–16:46

**Design and test of a compliance controller based on the piezoelectric-actuated compliant mechanism**  
Ruizhou Wang  
State Key Laboratory of Precision Electronic Manufacturing Technology and Equipment, Guangdong University of Technology, China

- A piezoelectric-actuated compliant mechanism (CM) equipped with two FSs and two PSs
- A CM-based force-position cooperative compliance controller.
- The CM-based compliance controller was verified to possess a higher precision.

### 30-3 16:46–16:59

**A Highly Compatible and Step-by-Step Temporary Bonding and Debonding Strategy for Ultra-Thin Wafer Level Package**  
Mengqi Yao, Xin Hao, Guoling Luo, Jie Deng, Guosheng Wang, Jiang Wang, Qian Dai, Jian Chen, Zungu Ke, Chikun Gong  
Southwest Institute of Technical Physics, Chengdu, China

- The thickness of thinned wafer is 50 μm with a small average TTV of 2.8 μm and a low fragmentation rate below 5%.
- This strategy offers a wide process window which can be compatible with wafer process conditions.
- The packaged device using the step-by-step temporary bonding and debonding technology shows an average yield of over 90%. 

Flexible Tactile and Proximity Sensors for Robotic Manipulation
Yonggang Jiang*, Yudong Cao, Jiacheng Li
School of Mechanical Engineering and Automation, Beihang University, China

- Endowing robots with multi-directional tactile sensing capabilities has long been a challenging task in the field of flexible electronics and intelligent robots. We present a highly sensitive flexible tactile sensor with an embedded-hair-in-elastomer (EHiE) structure.
- Inspired by near-field sensing functions of electric fish, we developed flexible tactile and proximity sensors for robotic manipulation, which have object recognition capability.

Tune undercut by adjusting gas in reactive ion etch
Deyong Wang
Department of Material and Production, Aalborg University, Denmark

- Theory of reactive ion etch.
- Etch Si(100) wafer without undercut.
- Fabricate microrobot by adjust recipe of reactive ion etch.
- Conclusion

Structural design and preparation of ultra-low density chemical-mechanical polishing pad
Liang Jiang
State Key Laboratory of Polymer Materials Engineering Polymer Research Institute, Sichuan University, China

- It is of great significance to develop an ultra-low density CMP pad to reduce scratches.
- One challenges is to prepare closed cell polyurethane pads with high porosity and low density.
- It adds diluent to reduce the system viscosity to prepare a low-density CMP pad.
- The density of the devised CMP is lower than 0.5 g/cc, even below 0.3 g/cc.

Macrophotograph and SEM images of ultra-low density CMP pad.
Polar Topologies in Oxide Films: From Preparations to Atomic Structures

Yun-Long Tang
Shenyang National Laboratory for Materials Science, Institute of Metal Research, Chinese Academy of Sciences, China

- Strain engineering was performed and Flux-Closure domains were prepared in PbTiO$_3$
- Atomic scale imaging of the Flux-Closure were recorded via a transmission electron microscope
- Polar maps based on the atomic images were achieved
- Other polar topologies as polar skyrmions will be introduced

A Flux-Closure in PbTiO$_3$ lattice under strain-engineering, based on the atomic scale imaging in a transmission electron microscope.
Dynamic Phase Transition leading to Extraordinary Plastic Deformability of Thermoelectric SnSe2 Single Crystal
Chongjian Zhou
State Key Laboratory of Solidification Processing, Northwestern Polytechnical University, China

- SnSe2 single crystal crystallizes in 18R low-symmetry structure rather than the trigonal and hexagonal-phase observed in the polycrystalline specimen
- Pressure drives SnSe2 phase converses from low to high-symmetry phase
- 15 MPa pressure erases energy gaps among different phases

The dynamic phase transition of SnSe2 results in a near isotropy plasticity along the direction parallel and perpendicular to the cleavage plane.

Routes to High-Ranged Thermoelectric Performance in Lead Chalcogenides
Yu Xiao
School of Materials and Energy, University of Electronic Science and Technology of China, China

- High average ZT value ($ZT_{ave}$) at wide temperatures is more important than maximum ZT ($ZT_{max}$).
- We developed synergistic routes, bandgap tuning and dynamic doping, to enhance $ZT_{ave}$ in lead chalcogenides.
- We achieved room-temperature ZT of 0.7, contributing to $ZT_{ave}$ above 1.0 at 300-873 K in PbTeSe.
- Contribute by Yu Xiao and Li-Dong Zhao

Achieving high-performance thermoelectric materials via structural modulation
Qiang Sun
West China Hospital of Stomatology, Sichuan University, China

- Electron microscopy, featured with extremely high resolution, is a powerful tool in understanding the structure of materials.
- The performance of thermoelectric materials can be highly influenced by their detailed structural characteristics.
- The link between thermoelectric performance and structural characteristics can be well established by extensively using new TEM techniques.
31-4  17:20–17:40

Plastically deformable inorganic semiconductors for thermoelectrics
Tian-Ran Wei
Shanghai Jiao Tong University, China

- Exceptional plasticity is found in $\text{Ag}_2\text{S}$ and InSe-like layered crystals, a new property to inorganic semiconductors.
- The plasticity is understood from multiple perspectives and a deformability index is proposed for material screening.
- Decent plasticity and thermoelectric performance are realized in a series of $\text{Ag}_2(\text{S, Se, Te})$ alloys and vdW crystals.

31-5  17:40–18:00

Magnetism-enhanced Thermoelectric Performance
Guoyu Wang
School of Materials Science and Engineering, Chongqing University, Chongqing 401331, China

- Huge magneto-transverse and longitudinal power factors were obtained in a magnetic Weyl semimetal $\text{TbPtBi}$
- The huge magneto-transverse power factor is caused by the large Hall Angle and the bipolar effect
- The magneto-longitudinal power factor is caused by the uncompensated hole and the high carrier mobility
- Introducing magnetism offers new opportunities in further thermoelectric performance improvement

31-6  18:00–18:20

Hidden Local Symmetry Breaking in Diamondoid Thermoelectric Compounds
Hongyao Xie
School of Materials Science and Engineering, Beihang University, China

- The ternary $\text{AMQ}_2$ diamondoid materials are a big family of wide band gap semiconductors.
- We discovered an unexpected local symmetry breaking in the Ag-based diamondoid compounds.
- This promotes a global distortion of the crystal structure resulting in ultralow lattice thermal conductivity.
- We achieved the $\text{ZT}_{\text{max}} = 1.5$–1.6 in a series of Ag-alloyed diamondoid compounds.
- Contribute by Hongyao Xie, Emil S. Bozin, Zhi Li and Mercouri G. Kanatzidis
The study of electro-mechanical phenomena in single CNTs in the cold field emission scheme using nanomanipulation

S.V. von Gratowski, V.V. Koledov
Laboratory of magnetic phenomena
Kotel’nikov Institute of Radioengineering and Electronics
RAS, Moscow, Russia

• Carbon nanotubes (CNTs) have unique mechanical, electrical, and electromechanical properties, and a single CNT itself can be considered as a subminiature nano-electromechanical system (NEMS). Also, electromechanical phenomena and luminescence can occur in CNTs under conditions of cold field emission. The paper reports about electromechanical and optical effects from single CNT in the cold field emission mode.

Influence of amorphous state local structure in TiNiCu alloys on structure and phase transformations during crystallization

Kirill Borodako, Victor Koledov
Kotel’nikov IRE RAS, Moscow, Russian Federation
Alexander Shelyakov, Olga Chernysheva
National Research Nuclear University MElPFI, Moscow, Russian Federation
Alexey Veligzhanin
National Research Centre “Kurchatov Institute”, Moscow, Russian Federation

• EXAFS-study of TiNiCu alloy samples in amorphous state revealed the dependence of the local atomic structure of the alloys on the copper content
• Studies of the structure of alloys by XRD showed that after quenching the alloys are in amorphous state
• Temperature intervals and the nature of martensitic transformations were determined by DSC

Formation of the developed surface of dental implants

E.A. Gosteva1,2, A.D. Dymnikov5, O.A. Sergienko1, U.E. Ershkulov2, V.A. Prokunin3
1 NUST MISIS, Russia
2 RUDN, Russia
3 IRE RAS, Russia

• The analysis of the obtained surfaces showed that the etching of titanium dental implants in solutions ethylene glycol and piranha indeed creates a developed surface that can potentially improve osseointegration properties.
• It was established that all the obtained samples, successfully passed mechanical testing and did not lose the acquired developed surface after imitation implantation

The work was supported by the Russian Science Foundation within the framework of project 22-19-00783.
Nanomechanical oscillating multi-purpose device based on alloy with shape memory effect

A. Prokunin, V. Koledov, A. Orlov
Kotelnikov IRE RAS, Moscow, Russia
A. Irzhak
IMT RAS, Chernogolovka, Russia
Peter Lega
RUDN University, Moscow, Russia
S. Romanov, A. Pavlov
Bauman Moscow State Technical University, Moscow, Russia

• SME oscillating device
• Nanomanipulation
• Heating system

Notes:
Janus plasmonic structures for high-efficiency solar-driven interfacial evaporation

Lei Shao
School of Electronics & Information Technology, Sun Yat-sen University, China

- Heat management with plasmonic near-field confinement-enhanced light absorption and sub-micrometer-scale heat localization
- Synergistic effects among the solar light absorption/photothermal conversion, thermal insulation and water supply components
- High solar-to-vapor conversion efficiency (99.1%) and high evaporation rate (3.04 kg m$^{-2}$ h$^{-1}$) at 1 sun
- Evaporation rate of 2.35 kg m$^{-2}$ h$^{-1}$ in a 10 wt% NaCl solution under 1 sun illumination

Enhanced oxygen vacancy formation on M/La$_2$O$_3$ and its influence on CO$_2$ hydrogenation

Zhong Changyin, Yifei Yang, Yunxi Yao
Institute of Materials, China Academy of Engineering Physics, China

- Transition metal modification decreases the formation energy of oxygen vacancy on La$_2$O$_3$ surfaces.
- Enhanced oxygen vacancy formation was observed at metal-oxide interfaces of MLa$_2$O$_3$ (M=Fe, Co, Ni).
- Interfacial oxygen vacancy offers sites for hydrogen adsorption spilled over from metal surfaces.
- Oxygen vacancy formed at metal-oxide interfaces show beneficial effect on CO$_2$ hydrogenation reaction.
- This paper provides new insights in the design of highly efficient La$_2$O$_3$-based catalysts.

Catalytic conversion of carbon dioxide

Hongliang Li*, Jie Zeng*
Hefei National Research Center for Physical Sciences at the Microscale, University of Science and Technology of China, China
lihl@ustc.edu.cn, zengj@ustc.edu.cn

- Thermal catalytic conversion of carbon dioxide into value-added products
- Electrochemical conversion of carbon dioxide
- Coupling electrolysis and synthetic biology to convert carbon dioxide into glucose and fatty acids
- Solvent/hydrogen-free upcycling of high-density polyethylene into separable cyclic hydrocarbons
Carbon dioxide conversion activated by photons and electrons
Qiang Huang
School of Optoelectronic Engineering, Chongqing University of Posts and Telecommunications, Chongqing

- Photocatalytic carbon dioxide conversion was demonstrated based on all-inorganic lead-free perovskites
- Non-equilibrium plasma with active electrons was used to activate carbon dioxide molecules
- The synergism between plasma and photocatalysts was achieved to improve the carbon dioxide conversion

Carbon dioxide conversion synergistically activated by non-equilibrium plasma and nano-photocatalysts

Exploration of metal-support interaction based on layered-metal-oxides for electrochemical water splitting
Yayun Pu
School of Optoelectronic Engineering, Chongqing University of Posts and Telecommunications, China

- TiO₂ morphology was controlled by phase transition from Lepidocrocite nanosheets to anatase
- Ultrafine Pt clusters were photochem-deposited on TiO₂ surface based on the intrinsic UV-Vis response of support
- Pt-TiO₂ interaction and surface state were in related to the hydrogen evolution

Two-Dimensional ReS₂ for Li-Ion Batteries and Photoreduction CO₂
Fei Qi
School of Optoelectronic Engineering, Chongqing University of Posts and Telecommunications, China

- Freestanding ReS₂/Graphene heterostructure was obtained through the in-situ synthesis.
- 3D RG as freestanding and binder-free anodes delivered better LIBs performances than bare ReS₂.
- 3D ReS₂@Cu₂O/Cu heterostructure was obtained via a drop-casting approach.
- ReS₂ improve the optical absorption and separation of photogenerated carriers to enhance the photoreduction CO₂ efficiency.

Figure 1. ReS₂ for LIBs and photoreduction CO₂.
MoS₂-FET-based Optical and Pressure Detectors

Chao Tan
College of Materials Science and Engineering, Sichuan University, China

- Tune the photoresponse of monolayer MoS₂ by decorating CsPbBr₃ perovskite nanoparticles
- It improves the photoresponse to 948 and 883 A/W @400 and 500 nm, with the detectivity of 10¹¹ Jones
- Fabricate the resin-gate dielectric FET to monitor the pressing behavior
- It has a continuous response to pressure and pressing time
- The sensor array can locate the pressing position

Figure Optical and pressure sensors with test results
A Novel Stacked-graphene-line Printing Method Enabled by Droplet Ejection and Micro-pen Writing

Jianing Niu, Xujiang Chao*, Hongcheng Lian, Jun Luo, Lehua Qi
School of Mechanical Engineering, Northwestern Polytechnical University, Xi’an

- A method of printing stacked graphene lines by micro-pen writing and droplet ejection is proposed
- The effect of micro-pen writing speed on the morphology of nanocellulose films is revealed
- The study might contribute to the miniaturized and integrated flexible devices

Setup and experiment for the fusion of molten and solidified micro-droplets in a simulated micro-gravity environment

1st Yichen Wang 2nd Yuxiang Xia, Yi Zhou, Jun Luo*, Lehua Qi
School of Material School of Mechanical Engineering Northwestern Polytechnical University, China

Uniform droplet-based manufacturing is advantageous for on-orbit metal additive manufacturing.
- A novel fusion setup was designed to test fusion of molten and solidified tin-lead droplets in microgravity (µG-MDF).
- The fusion process was successful, obtaining spherical, neatly fused droplet samples.
- This provides a foundation for conducting uniform aluminum micro-droplet fusion experiments in the drop tube.

TA@Au nanoflower-assisted laser desorption/ionization mass spectrometry for metabolite detection

Dingyitai Liang
School of Biomedical Engineering, Shanghai Jiao Tong University, China

- We synthesized TA@AuNFs using a one-pot green method.
- TA@AuNFs exhibited better detection performance for standard molecules.
- This nanoplatform was successfully employed to profile metabolic fingerprint in complex body fluids.
34-4  08:45–09:00

Electrospun polyfunctional switch-typed 3D or 3D plus 2D structures endued with anisotropic photoconductivity-magnetic-fluorescent performances

Yuan Zhou
School of Materials Science and Engineering, Jilin Jianzhu University, China

- Switch-typed anisotropic photoconductive Janus film, Janus tubes and 3D plus 2D full flag structures are proposed for the first time.
- Multi-function of the materials can be adjusted by controlling the illumination.
- Photoactive semiconductor materials used for anisotropic conductive films for the first time.

34-5  09:00–09:15

Submillimeter-scale flexible micro-catheters driven by shape memory alloys for vascular interventions

Chengyang Li, Kecai Xie, Jingkai Wang, Jizheng Li, Zhongjing Ren*, Peng Yan
School of Mechanical Engineering, Shandong University, China

- The SMA wires biasedly embedded in the silicone rubber base enabled controllable bending of flexible micro-catheters with submillimeter diameter.
- Fabrication and assembly of the active micro-catheter were experimentally validated and optimized.
- A catheter feeding mechanism was built for robotic control of submillimeter catheter in blood vessels.

Contribution: Submillimeter-scale flexible micro-catheters, as well as their feeding mechanism, were developed for active navigation in blood vessels.

34-6  09:15–09:30

Preparation of Micro Gripper Pincer End with Superhydrophobic Surface and Analysis of Gripping Performance

Meng Wang, Na Ni*, Zhen Yang*
School of Mechanical Engineering, Tianjin University, China

- Bionic superhydrophobic surface was fabricated on micro gripper pincer end face.
- The formation mechanism of superhydrophobic surface was revealed.
- Micro gripper with a superhydrophobic clamp surface effectively resists impurity adsorption and facilitates the effective release of small grasped objects.
Technical Session 34  
Microrobotics and Automation I  
Room 2  
8:00-10:00 Thursday, 3 August  
Chair: Xiaozhan Yang  
Co-Chair: Dan Xia

34-7  09:30–09:45

**Fabrication and Optimization of Single Nanowire Optoelectronic Devices Based on Atomic Force Microscope**

- Xin Pan  
  ZJU/UIUC Institute, Zhejiang University, China
- Zhiyao Zheng  
  ZJU-Hangzhou Global Scientific and Technological Innovation Center, China
- Yang Xu  
  ZJU-Hangzhou Global Scientific and Technological Innovation Center, China  
- Huan Hu  
  ZJU/UIUC Institute, Zhejiang University, China

- Manipulate nanowire in nanoscale with Atomic Force Microscope
- Manipulate single ZnO nanowire to make contact with graphene to create photodetectors
- Use AFM force mapping mode to enhance photodetector characteristics

**Notes:**

34-8  09:45–10:00

**A Method to Solve the Influence of Local High Temperature on Automatic Focusing of Infrared Imaging**

- Yaming Zhuang  
  Southwest Institute of Technical Physics

- When high-temperature objects such as huge fire pits, tail flame of airplanes appear in the scene, based on the traditional SOBEL operator to calculate the grayscale gradient of images for automatic optical focusing, the infrared image response will be very large, and the grayscale will become very high, leading to the failure of the SOBEL operator and the failure of focusing. This article successfully solves the above problem by introducing grayscale average assistance.
Structural Dynamics Analysis of Endebius Florensis’ Hindwing

Yongwei Yan, Fa Song, Wenzhe Wang, Nuo Xu, Haocheng Zhu, Pengpeng Li, Jiyu Sun*
Key Laboratory of Bionic Engineering, Jilin University, China

• The bionic hindwing model was established by morphological data and nanomechanical properties.
• The modal analysis was carried out to obtain the resonant frequency and mode shapes.
• Based on modal analysis, the structural dynamics of the model was analyzed.

Analysis of aerodynamic characteristics of bionic flapping wing

Fa Song, Yongwei Yan, Nuo Xu, Yanyu Zhou, Wenzhe Wang, Haochen Zhu, Jiyu Sun*
Key Laboratory of Bionic Engineering, Jilin University, China

• Effects of flapping frequency and Angle of attack on aerodynamic characteristics of bionic flapping wing.
• Lift-drag ratio and flow field diagram analysis of bionic flapping wing in unit period.
• The study of aerodynamic characteristics is helpful to the design of FWMAVs in the future.

Study on continuous corrosion process of self-healing coating with micro-nano capsule

Yueming Wang
School of Engineering, Huzhou University, Huzhou 313000, Zhejiang, China;

• The continuous corrosion process plays an important role in the coating deterioration process.
• Continuous corrosion process, surface roughness, and corrosion morphology are investigated.
• It will provide scientific research significance for the dynamic corrosion behavior.
Application research on multi-dimensional protection of gas pipeline against abrasion
Yueming Wang
School of Engineering, Huzhou University, Huzhou 313000, Zhejiang, China;

• The problem of gas pipeline abrasion has become a major scientific and technical problem facing the gas pipeline.
• In view of gas pipeline corrosion problem, multi-dimensional protective measures such as gas pipeline and attached equipment materials gas pretreatment, new organic anti-corrosion materials and anodic protection for different parts and working conditions are systematically researched in order to achieve the overall protective effect.

Metallic black color obtained by two microstructures in elytron scales of Sagra femorata purpurea Lichtenstein
Wei Wu¹, Li Liang¹, Pengfei Xu¹, Zhihong Zhang¹, Zhengxuan Hu¹, Chengbo Ju¹, Jiya Sun²
¹ School of Mechanical Engineering, University of Shanghai for Science & Technology, Shanghai,
² Key Laboratory of Bionic Engineering (Ministry of Education, China), Jilin University, Changchun,
Corresponding author: weiwuxst@163.com

• Special existence compared to other purple, purple-red and green S. f. p. Lichtenstein formed by microstructures;
• Circular convex closures have influence on angle dependent color changing while the incident angle less than 30°;
• The excessive thick layer in EPI can reflect and refract incident light irregularly at different angles;
• Metallic black appearance results from synergistic optical actions.

Figure Color formation mechanism and its optical analysis results
Advanced pure copper localized electrodeposition with sub-micron resolution

Wanfei Ren
Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing, Changchun University of Science and Technology, China

- Propose a mathematical model of the synergy of pulsed micro-jet, focusing electric induction and atomic force servo.
- The manufacture of pure copper microstructure is realized, and the deposition rate can reach 0.887 μm/s.
- Tested the shear modulus of pure copper microspring, reaching 60.8 GPa.
- The Z-direction position of the atomic force probe and the bending state of the cantilever can be detected online at the same time.

Performance study of 266nm UV nanosecond laser micromachined glow discharge polymer films

Rutian Chen
Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing
College of Mechanical and Electrical Engineering, Changchun University of Science and Technology
Changchun, Jilin Province, China

- When the scanning speed increases, the surface quality of the GDP material increases.
- As the laser energy density increases and the number of scans increases, the surface quality of the GDP material decreases.

Localized electrochemical deposition for additive manufacturing of 3D array metal microstructures

Manfei Wang
Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing
College of Mechanical and Electrical Engineering, Changchun University of Science and Technology
Changchun, Jilin Province, China

- The manufacturing of three-dimensional array metal microstructures is currently a key and challenging issue in the manufacturing field.
- This technology can manufacture columns, arrays, and complex metal microstructures.
- The microstructure produced has elevated purity (99.5%), low environmental dependence, elevated surface quality, simple preparation, low cost, and controllable structure.
Flow field analysis of cylindrical array structure in electrochemical machining Titanium alloy blades

Haoran Deng
School of Mechanical and Electrical Engineering, Changchun University of Science and Technology, China

- In this paper, cylindrical array structure cathodes are proposed by laser ablation.
- Microstructure cathodes can achieve stable TC11 titanium alloy blades machining.
- Analysis of the array cylindrical flow field and enhancement surface quality of experimental processing.

Research on Classification and Recognition of Micro Milling Tool Wear Based on Improved DenseNet

Zhaoxiang Li
School of Mechanical and Electrical Engineering, Changchun University of Science and Technology, China

- In this paper, an improved DenseNet model was proposed to identify and classify the wear states of micro-milling tools.
- Construct a tool wear dataset, the expanded dataset facilitates model convergence.
- The Inception structure and SE block can improve the performance of the neural network.

Evaluation Method for Digital Holographic Autofocusing of Micro Milling Tools

Haoyang Yu
Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing
Changchun University of Science and Technology

1. Proposed a segmented progressive autofocus algorithm
2. Compare clarity evaluation functions
3. Conduct simulation experiments to obtain applicable focus evaluation methods

Discusses the change rule of the image definition generated by coarse focusing and fine focusing in the process of Digital holography auto focusing, as well as their applicable auto focusing methods.
**Experimental study on ultrasonic assisted helical grinding of SiC/SiC composites**

Kaiming Fu  
Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing  
College of Mechanical and Electrical Engineering, Changchun University of Science and Technology  
Changchun, Jilin Province, China

- The single abrasive finite element simulation cutting model of UVAHG is established.  
- UVAHG can improve the surface quality of SiC/SiC composites and improve the removal form of fibers.  
- UVAHG can effectively reduce the burr and edge breakage phenomenon of the inlet and outlet holes.

**Simulation and Experimental Study of C/SiC Composites by Laser-ultrasonic Hybrid Micromachining**

Jicheng Li  
Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing  
College of Mechanical and Electrical Engineering, Changchun University of Science and Technology  
Changchun, Jilin Province, China

- L-UHM simulation model based on orthogonal cutting model  
- In L-UHM, lower surface roughness and higher surface quality were obtained.  
- Surface roughness improved by 29.9% and 35.3% at 60W/mm² and 3µm respectively
Photoluminescent Semiconductor CdS Magic-Size Clusters from Their Precursor Compounds
Kui Yu
National Engineering Research Center for Biomaterials, Sichuan University, China

- Magic-size clusters (MSCs) evolve from their precursor compounds (PCs). Non-photoluminescent (PL) CdS MSC-328 transforms to PL CdS MSC-328 and MSC-373.
- Acetic acid (HOAc) assists the transformation of the PC. PC-322 quasi-isomerizes to PC-328 via monomer substitution, and PC-328 transforms to PC-373 via monomer addition.
- S dominates the PC/MSC composition, and Cd mainly controls the PC/MSC structure and thus optical properties.

Green and Sustainable Materials for Energy Storage and Conversion Applications
Qiliang Wei
Institute of Micro/Nano Materials and Devices, Ningbo University of Technology, China

- Carbon based non-precious-metal catalysts for oxygen reduction reaction.
- From proton-exchange-membrane fuel cell to anion-exchange-membrane fuel cell.
- Advanced materials for Zn-based aqueous batteries.

Rational design of eco-friendly colloidal quantum dots for solar energy conversion
Xin Tong
Institute of Fundamental and Frontier Sciences, University of Electronic Science and Technology of China, China

- Eco-friendly colloidal quantum dots are used as light harvesters to achieve high-efficiency photoelectrochemical hydrogen generation.
- Surface and interface engineering enables suppressed charge recombination and enhanced photo-stability.
- Element doping and alloying in eco-friendly core/shell quantum dots can optimize the photoinduced charge transfer dynamics.
Regulation of charge/exciton distribution for white OLEDs/colloidal quantum well LEDs
Baiquan Liu
School of Electronics and Information Technology, Sun Yat-sen University, China

• White organic/colloidal-quantum-well have great potential to the display and lighting technology.
• Charge- and exciton- dynamics in white OLEDs/colloidal quantum well LEDs have been comprehensively discussed.
• High-performance white OLEDs and CQW-LEDs have been achieved.

Synthesis and Application of Transition Metal Dichalcogenide-based Heterostructures
Junze Chen
College of Materials Science and Engineering, Sichuan University, China

• Several kinds of transition metal dichalcogenide based heterostructures are successfully synthesized.
• The obtained heterostructures show excellent catalytic activities in water splitting.
• The catalytic active site of MoS$_2$ for HER is revealed by SERS.
Advancements of n-type organic cathodes for Na-ion batteries
Cong Fan
School of Materials and Energy, University of Electronic Science and Technology of China (UESTC), Chengdu 611731, China

• Organic cathodes suffer serious dissolution problem in Na-ion batteries.
• Strategies are applied to solve this problem.
• Novel n-type insoluble organic cathodes are designed.
• High-performance full Na-ion batteries are constructed.

Materials Design for Highly Reversible Metallic Lithium Batteries
Chaozhu Shu
College of Materials and Chemistry & Chemical Engineering, Chengdu University of Technology, P. R. China

1. Solvation environment of Li+ ions is regulated by using high donor number salt anion.
2. Tf with high donor number can favorably enter the inner solvation sheath of Li+ ions.
3. The stable interphase enriched with LiF is beneficial for dendrite-free Li deposition.
4. Cu@Li||Li and Cu@Li||LiFePO4 cells deliver excellent performance.

Research on the Supercritical Etching Method of MXene and Its Multifunctional Applications
Weiqing Yang
Research Institute of Frontier Science, Southwest Jiaotong University, Chengdu, P.R. China

• We propose supercritical etching methods for various 2D MXenes assisted by supercritical CO2.
• The optimum preparation time and scale for MXenes are 1 h and 1 kg respectively.
• We have fabricated multifunctional MXene-based devices, e.g. energy storage device, and sensors.
• This paper provides new ideas for the large-scale preparation and multifunctional application of MXene.
Charging Mechanisms under confinement: Molecular Dynamics Simulation Study
Kui Xu
School of Flexible Electronics (Future Technologies), Nanjing Tech University, China

- Nanoconfinement has deeply effects to the charging mechanism, at both thermodynamic and kinetic perspectives.
- Molecular dynamics methods can effectively simulate the confinement behavior of nanofluids under working conditions.
- Simulation results demonstrate that the charging mechanisms are changing consistently with the anion size and the surface charge of the electrode.

Charge Storage of MXenes in nonaqueous electrolytes
Zifeng Lin
College of Materials Science and Engineering, Sichuan University, China

- MXenes are gaining increasing interesting as energy storage materials.
- Ti$_3$C$_2$T$_x$ (T$_x$= -OH, -F) exhibit battery-type Li$^+$ storage with low rate and low efficiency in LP30 electrolyte.
- Ti$_3$C$_2$T$_x$ (T$_x$= -O, -Cl) show pseudocapacitive Li$^+$ storage behavior with high-rate performance in LP30 electrolyte.
### Technical Session 39

**Nanomanipulation and Nanopositioning II**

Room 7

8:00-10:00 Thursday, 3 August

Chair: Yongxiu Song

Co-Chair: Yuxi Huang

<table>
<thead>
<tr>
<th>Session</th>
<th>Time</th>
<th>Title</th>
</tr>
</thead>
</table>
| 39-1    | 08:00–08:17 | **Development of a Micromanipulator Robot for Cell Injection with Sub-picoliter Scale**  
*Shuo Zhan  
Xlab, Jhualab, China*

- Developed a micromanipulator robot for cell injection
- Developed a motion strategy based on visual feedback for automatic injection
- Designed a controller based on PID and integrated sliding mode algorithm for sub-picoliter scale injection
- This paper presents a automatic micromanipulator robot system with high-precision in sub-picoliter scale injection

| 39-2    | 08:17–08:34 | **Droplet-based Microfluidic Platform for High-throughput Formation of Multicellular Spheroids**  
*Zhen Zhan, and Chengzhi Hu  
Department of Mechanical and Energy Engineering, Southern University of Science and Technology, China*

- A capillary microfluidic method was developed to fabricate heterogeneous spheroids with the structural complexity of interior morphologies.
- The fabricated hydrogel microspheres provide useful platform for cell 3D growth.
- MSCs and HUVECs were co-cultured to build a vasculized heterogeneous bone tissue construct.
- Contributing novel biomimetic asymmetrical prototypes for tissue engineering and basic medical research.

| 39-3    | 08:34–08:51 | **A technique for reducing the velocity of protein translocation**  
*Zhen Zhang  
School of Mechanical Engineering, Southeast University, China*

- Verify the feasibility of the program
- Analyze the ionic currents and the number of residues during protein translocation with time
- Reveal the mechanism of protein deceleration due to carbon nanotubes
A monolayer carbon nitride on Au(111) with a high density of Co sites: structure and catalytic activity
Zhaozong Sun
Interdisciplinary Nanoscience Center, Aarhus University, Denmark

- 2D CoNC sample with well-defined Co-N sites is made by a facile pyrolysis way
- Catalytic activity towards OER and ORR are measured showing high reactivity
- Cycled measurement indicates much higher stability than the corresponding oxides
- The catalytic properties are linked directly to the specific structural sites

Self-Assembly of Janus Graphene Oxide for Scalable High-performance Memristors
Fei Hui
School of Material Science and Engineering, Zhengzhou University, China

- Obtain large-area uniform Janus graphene oxide (J-GO) films via chemical-breakdown and self-assembly of GO flakes at o/w interface
- Construct J-GO based memristive crossbar array with enhanced performance (e.g., low operation voltage ~0.3 V, high endurance >12,000 cycles)
- Emulate typical electro-synaptic plasticity (e.g., EPSC, STP/LTP) and propose a promising application in artificial neural network.

Flexibility of ultrafast Bessel Beams for the volume engraving of glasses
Jorge Fantova\textsuperscript{a,b}, Ainara Rodríguez\textsuperscript{a,b}, Jesús del Hoyo\textsuperscript{c}, Gemma G. Mandayo\textsuperscript{a,b}\textsuperscript{1}, Santiago M. Olaizola\textsuperscript{a,b}\textsuperscript{1}
\textsuperscript{a}Ceit-BRTA, Spain
\textsuperscript{b}University of Navarra, Tecnun, Spain
\textsuperscript{c}Applied Optics department, Complutense University of Madrid, Spain

- Volume gratings embedded in optical glasses using ultrafast Bessel beams.
- Nonlinear properties of each material led to great differences in laser damages.
- Generated Raman-Nath and Bragg gratings exhibit up to 70% diffraction efficiency.
- Bessel beams enable high throughput and versatile bulk processing strategies.
Fabrication of thin-wall structures with femtosecond laser and stainless steel powder

Santiago M. Olaizola
1. CEIT-Basque Research and Technology Alliance (BRTA)
2. Universidad de Navarra, Tecnun
San Sebastian, Spain

- Investigation of femtosecond laser as a tool to create thin-walled structures
- Scanning strategy found highly influential for fabrication of thin profiles
- Analysed the relation between theoretical and measured wall thickness for different processing conditions
- Wall thicknesses down to 90 μm have been achieved

Thin wall SEM image (up) and vertical wall magnification (down)
**Technical Special Session 40**
Micro-nanostructure Manufacturing and Applications (ss)
Room 1
10:20-12:20 Thursday, 3 August
Chair: Litong Dong
Co-Chair: Wenjun Li

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**40-1 10:20–10:32**

Realizing micro-patterned laser-reduced graphene for antiviral surfaces

Fanyue Kong
International Research Centre for Nano Handling and Manufacturing of China

- The antiviral performance against bovine viral diarrhea virus (BVDV) of micro-patterned RGO surface compared to GO surface and petri dish were evaluated.
- Use Arial 28pt font in bold face for the title
- micro-patterned, reduced graphene oxide, laser direct-writing technology, surface antiviral

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**40-2 10:32–10:44**

Fabrication of Copper Nanoparticle Antiviral Surfaces by Laser Direct Writing

Feiyue Zuo
International Research Centre for Nano Handling and Manufacturing of China

- A simple and efficient antiviral surface of copper nanoparticles was prepared by laser direct writing, which can effectively kill the virus, providing a way to reduce the spread of the virus, and the antiviral mechanism of Cu nanoparticles was discussed.
- Copper nanoparticle, laser direct writing technology, antiviral surfaces

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**40-3 10:44–10:56**

Fabrication of Cu-doping Micro-nano Grooved Structures on Ti6Al4V Alloy by Laser Direct Writing

Wenjun Li, Huanghao Zeng, Ri Liu and Fanyue Kong
International Research Centre for Nano Handling and Manufacturing of China, Changchun University of Science and Technology, Changchun, China
liwenjun_axa@163.com

- In this paper, the micro-nano grooved structures with a period of 70um were prepared on the surface of Ti6Al4V alloy by fiber laser direct writing technology, and Cu was doped on the grooves by ion sputtering and annealing processes.
- The effects of laser power and scanning speed on the topography and feature size of grooved structures on Ti6Al4V alloy surface were studied. The topography was characterized by scanning electron microscopy (SEM). The results showed that the micro-nano grooved structures were formed when the laser power was 12W and the scanning speed was 10mm/s.
- The effect of Cu-doping on micro-nano grooved structures was studied by adjusting the Cu doping from 1% to 53.1% by ion sputtering. The results of elemental analysis (EDX) showed that the nanostructures were generated on the micro grooved structures when the Cu-doped content was 19.1%.
**A morphology control method of submicron SiO$_2$ arrays in CHF$_3$/Ar inductively coupled plasma etching**

Zhibo Zhang

Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing, Changchun University of Science and Technology, China

- Inductively coupled plasma (ICP) etching is used for the SiO$_2$ etching.
- Anisotropic etching of the SiO$_2$ by the CHF$_3$ / Ar mixed gas under the Cr mask.
- Influence of etching period, temperature, RF power and ICP power on SiO$_2$ etching profile morphology.
- Methods for regulation and manufacture of SiO$_2$ submicron array structure.

**Study on the Removal Mode of Ultra-precision Polishing Process of Ceramic Materials**

Zhuolin Li

Moral Education • Integrated Teaching and Research Training Department. Jilin Provincial Institute of Education, China

- The computer Control Ultra-precision Polishing ultra-precision flexible airbag polishing technology is used to study the optical surface polishing characteristics of silicon carbide material.
- Using the Taguchi method, the main parameters of polishing angle, rotation speed, pressure and compensation depth are studied to determine the optimal process parameters of ultra-precision polishing of ceramic surface.

**Effect of sputtered oxygen flux on electrical properties of nanometer-thin ITO transistors**

Jiabing Li

School of Electronic Science and Engineering, University of Electronic Science and Technology of China (UESTC), China

- Ultra-thin 4nm bottom gate indium tin oxide transistors
- Effect of oxygen flux on transistor electrical properties in radio frequency magnetron sputtering
- The important role of oxygen in radio frequency magnetron sputtered indium tin oxide films
IR Cut-off Film of Target Microstructure Surface Scattering Parameters
Bogi Wu
Department of Electrical and Computer science, Key Laboratory of the Ministry of Education for Comprehensive Energy Conservation in Cold Buildings, China

• A merit function was built, and a film was designed in which the electric field intensity was lower and reflectivity was higher, through the simulated annealing algorithm.
• By simulating curve, the functional monotonicity of the reflectivity was studied.
• It was determined that the ratio between high and low index material has an impact on the equivalent refractive index function and reflectivity.

A Large-area Nanograting as SERS Substrate by Displacement Talbot Lithography
Yue Wang
Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing, Changchun University of Science and Technology, China

• Effect of different duty cycles on the electric field intensity of gold nanograting simulated by FDTD.
• Fabrication of nanograting pattern by Displacement talbot lithography.
• Fabrication of gold nanograting by Physical vapor deposition technology.
• Raman spectroscopy detection of SERS substrate using R6G molecule.

Flexible AZO Thin Film Transistors Fabricated at Room Temperature
Chao Wang
Key Laboratory for Comprehensive Energy Saving of Cold Regions Architecture of Ministry of Education, Jilin Jianzhu University, China

• Flexible AZO-TFTs were successfully fabricated on PI substrate by RF magnetron sputtering.
• The flexible TFTs were prepared via room temperature without any thermal annealing process.
• The optimized flexible TFT demonstrates excellent electrical characteristics with an \( I_{on}/I_{off} \) ratio of \( 5.23 \times 10^5 \).
• This work brings the industry one step closer to green flexible displays and wearable applications.
Effect of Oxygen to Argon Ratio on the Performance of AZTO Thin Film Transistors

Chao Wang

Key Laboratory for Comprehensive Energy Saving of Cold Regions Architecture of Ministry of Education, Jilin Jianzhu University, China

- AZTO-TFTs device were successfully prepared by RF magnetron sputtering method.
- All functional layers of the TFTs are rare-metal-free.
- Through optimizing Ar/O\textsubscript{2} ratio, AZTO TFTs exhibited excellent performance, including an I\textsubscript{on}/I\textsubscript{off} ratio of 1.83 \times 10\textsuperscript{8}.
- This device was suitable for active devices in low cost display and environmentally friendly applications.
41-1 10:20–10:35

DNA Network Construction by Optically Induced Dielectrophoresis
Changheng Li
Changchun University of Science and Technology, China

- Optically induced dielectrophoretic force field was used in manipulating deoxyribonucleic acid.
- The DNA network close to the actual height helps analyze its electrical conductivity.
- ODEP can be used as the tool to manipulate DNA and structure DNA molecular devices.

The AFM images of DNA in different areas of ODEP field.

41-2 10:35–10:50

The Influence of Polarization on the Optical Field Distribution in 4+1 Beam Laser Interference
He Wen
International Research Centre for Nano Handling and Manufacturing of China(CNM), Changchun University of Science and Technology, China

- Application of the multi-beam laser interference intensity formula in MATLAB.
- 4+1 beam interference two-dimensional and three-dimensional optic field simulation.
- 4+1 beam laser interference optic field polarization modulation.

41-3 10:50–11:05

Study of single point incremental sheet metal forming trajectory generation
Kuangyu Chen
School of Mechanical and Precision Instrument Engineering, Xi’an University of Technology, Shaanxi, China

- The relationship between forming angle and incremental arc length was established.
- The generation of contour trajectories was controlled based on ellipsoidal section part shapes.
- The overall forming quality of the contour trajectories with equal arc lengths based on the dispersion of the lower pressure point is better.

Figure: Forming accuracy for different forming trajectories.
Mesoporous Platinum Nanospheres for Sensitive Detection of Small Metabolites by Mass Spectrometry
Ziyue Zhang
School of Biomedical Engineering, Shanghai Jiao Tong University, China

• Synthesized porous Pt nanoparticles through a simple surfactant-direction method.
• Achieved sensitive detection of metabolites with a low LOD compared to organic matrices.
• Enhanced metabolic analysis in complex biofluids without sample treatment procedures.

Study of the sensitivity of MAPbI₃ radiation detectors based on Monte-Carlo simulation
Feng Qin
China Jiliang University, Hangzhou, China
Wei Feng Zhu, Xian Qiang Tang
Chengdu University of Technology, Chengdu, China
Ning Qin Deng*, Jin Jie Wu*
National Institute of Metrology, Beijing, China
Rui Zhao
National Institute of Metrology, Beijing, China
Zhi Wei Jiao*
China Jiliang University, Hangzhou, China

• Mass attenuation coefficient: The mass attenuation coefficient of MAPbI₃ is higher than that of α-Se and MAPbBr₃.
• Charge collection efficiency: Higher external voltage is necessary to maintain an efficient Charge collection.
• Detection sensitivity: Exhibits the maximum detection sensitivity when exposed to 80 keV energy rays.
• This study employed Geant4 Monte-Carlo simulation to determine the detection sensitivity of MAPbI₃ radiation detectors and identify the optimal physical conditions for achieving maximum detection sensitivity.

Fabrication of superhydrophobic hierarchical structures on PET surfaces by hot embossing with in situ growth of silver nanoparticles
Siyuan Fan
International Research Centre for Nano Handing and Manufacturing of China, Changchun University of Science and Technology, China

• Fabrication of superhydrophobic hierarchical structures on PET surfaces by hot embossing with in situ growth of silver nanoparticles (Ag NPs).
• Surface features a micro-nano composite structure, with micron-scale stripes overlaid by nanoscale bumps formed by Ag NPs.
• The contact angle (CA) of the surface can reach 162°.
• Opens up new possibilities for fabricating superhydrophobic surfaces on thermoplastic materials like PET and expands the potential applications of PET in various fields.
Technical Session 41
Microrobotics and Automation II
Room 2
10:20-12:20 Thursday, 3 August
Chair: Chao Tan
Co-Chair: Siyuan Fan

41-7 11:50–12:05

Fabrication of Superhydrophobic Carbon Fiber via Laser Interference
Xiubo Liang
International Research Centre for Nano Handling and Manufacturing of China
Changchun University of Science and Technology
Changchun, China

• Direct Laser Interference Lithography for large-scale metal template processing
• Large-scale Fabrication Based on Template Hot Embossing
• Realization of Superhydrophobic Function in Carbon Fiber/Epoxy Resin Composite Materials

41-8 12:05–12:20

A PID Based on RBF Neural Network for a Material Weighing and Proportioning System
Jiayi Chu
the College of Information Science and Technology, Donghua University, China

• A PID controller based on RBFNN is designed for the material weighing and proportioning system.
• RBFNN is used to establish the system model, provide gradient information for controller parameter adjustment.
• The validation of the design scheme is verified by experiments.
140

Technical Session 42
Bio-nano Devices and Applications
Room 3
10:20-12:20 Thursday, 3 August
Chair: Laiming Jiang
Co-Chair: Yue Wang

42-1 10:20–10:33

Pore-peptide Interaction Study of Polycationic-carried Amino Acid for Protein Sequencing
Mu Chen, Jun Ren, Yunfei Chen*
School of mechanical engineering, Southeast University, Nanjing, China

- Computationally simulated the single amino acid under the traction of polypeptide cationic carrier
- Periodic fluctuation of SMD forces was observed, reflecting the response of the nanopore.
- Energy barriers provided a reasonable explanation for the difference of pore-peptide interaction.
- These findings may pave the way to solid-state nanopore protein sequencing.

Notes:

42-2 10:33–10:46

Study on the antibacterial effect based on ZIF-8@RF@Ag reagent
Na Li, Yexing Wang, Diheng Yuan, Chong Zhang and, Zuobin Wang*, Xuxia He*
School of Life Science and Technology, Changchun University of Science and Technology, Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing, Changchun University of Science and Technology, China

- The Ag@RF@ZIF-8 composite nanomaterials were synthesized by one-pot method
- Ag@RF@ZIF-8 is pH responsive and releases RF at the site of bacterial infection, and RF and AgNPs have synergistic antibacterial effects
- Plate counting method and crystal violet staining method proved that the synthesized Ag@RF@ZIF-8 composite nanomaterials had significant antibacterial effect

Notes:

42-3 10:46–11:00

The effect of anion hydration lubrication near the negative solid surface
Canjun Wen, Yajing Kan
Jiangsu Key Laboratory for Design and Manufacture of Micro-Nano Biomedical Instruments, School of Mechanical Engineering, Southeast University, China

- Use AFM research the hydration lubrication of ions
- Explore the lubrication effect of acetic acid root ion at different concentrations
- Reveal the internal reasons for the different lubrication effects of acetate ions at different concentration

Notes:
Tribological Behavior of Medium Molecular Weight Chitosan in Acid Aqueous Solution
Qiang Yang
School of Mechanical Engineering, Southeast University, China

- The intermolecular interaction between chitosan-coated surfaces was measured by SFA.
- The topographies of the chitosan-coated surface and the mica surface were imaged by the AFM.
- Shear response characteristics and load-bearing characteristics were discussed.
- Our findings provide useful information in understanding the tribology mechanism of soft materials.

Surface Modification of Co-Cr-Mo Alloy to Improve Antibacterial and Biocompatibility
Feifei Zou
Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing, Changchun University of Science and Technology, China

- Silver coating can significantly improve the antibacterial performance of Co-Cr-Mo alloy, enhance hydrophilicity, and achieve a antibacterial rate of 100%.
- Periodic stripe structures can enhance surface hydrophobicity, regulate cell growth direction, and promote cell.
- It has great prospects in the field of Bone grafting.

Research Progress of Immune Cells Against Tumor
Yue Wang
International Research Centre for Nano Handling and Manufacturing of China, Changchun University of Science and Technology, China

- Autoimmune cells specifically recognize, intervene and kill tumor cells.
- Cellular immunotherapy has shown remarkable effects in more cancer types.
- The combination of traditional tumor therapy and cellular immunotherapy is of great significance.
- This article introduces the immune cells in anti-tumor process to provide reference for tumor therapy.
Laser-induced zinc metal battery anodes with ultra-long cycling performance

Zhen Yang, Bingyu Li, Chengjuan Yang*
School of Mechanical Engineering, Tianjin University, China

- Nanosecond laser ablation was employed to modify zinc foil.
- Laser-induced zinc surface showed super-hydrophilic and zincophilic properties.
- For symmetric cells, laser-induced zinc anode showed lower nucleation potential and stable plating/striping behavior.
- For full cells, laser-induced zinc anode presented ultra-long cycling performance with high CE values.

Study on Multifunctional MOF Nano Drugs Toxicity for Targeted Diagnosis and Treatment of Colorectal Cancer

Yexing Wang, Chong Zhang, Chenkai Zhu, Jingqi Feng, Zuobin Wang* and Xiaoxia He* 
School of Life Science and Technology, Changchun University of Science and Technology, Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing, Changchun University of Science and Technology, China

- The ZIF-8@DOX-Ti nanocomposites were prepared by one-pot method.
- ZIF-8@DOX-Ti has pH response, specifically targets cancer cells under the action of targeting peptides, and has anticancer effects.
- MTT assay and hemolysis assay demonstrated the biosafety and antitumor effect of ZIF-8@DOX-Ti.

Soft but strong magnetic medical machines

Yichao Tang 1, Metin Sitti 2
1 Mechanical Engineering, Tongji University, China
2 Max Planck Institute of Intelligent Systems, Germany

- The softness of magnetic soft actuator severely limits its overall functionality and applications.
- We report a class of miniature magnetic actuators that exhibits a large output force and high work capacity, 10^4 times better than the existing soft magnetic actuator.
- We show the actuator’s capabilities by a few application demonstrations towards different medical functions.
- We believe our actuators could advance the field and be used in a variety of medical applications.
43-1  10:20–10:37
Optimization and experimental study of the cathode in array microchannel copy electrochemical machining
Huifui Sun
Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing
College of Mechanical and Electrical Engineering, Changchun University of Science and Technology
Changchun, Jilin Province, China

• The distance between cathodes is optimized to reduce stray corrosion.
• The channel contour evolution with different time steps is simulated.
• The experimental results show that the optimal spacing is 1.4 mm, consistent with the simulation results.

Microchannel profiles with different cathode spacing

43-2  10:37–10:54
Application of Optimization Algorithm in Meniscus-Constrained Electrodeposition of Three-Dimensional Metal Microstructure
Xue Wang
Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing
College of Mechanical and Electrical Engineering, Changchun University of Science and Technology
Changchun, Jilin Province, China

• This method can avoid many experiments and reduce the waste of materials and money.
• Algorithm optimization can obtain parameters that fit better with the target deposition rate, improving accuracy and reliability.
• Parameter optimization can improve the performance of metal microstructures, and the study results are an essential guide for experiments.

(a), (b) for the first and second LSM images of experimental results at 350 s; (c), (d) for the first and second experimental results at 500 s.

43-3  10:54–11:11
Study on wear evaluation of cemented carbide micro milling cutter
Ye Zhang
School of Mechanical and Electrical Engineering, Changchun University of Science and Technology, China

• This paper takes cemented carbide micro milling cutter as the main research object.
• According to the wear mechanism of micro milling cutter, the corresponding evaluation parameters are selected for the test.
• Finally, according to the analysis of experimental data, the evaluation index of micro milling cutter bluntness is obtained.

Fig 1. Test equipment and tools.
Monitoring Method of Acoustic Emission Technology for Micro Texture of PCD Tool

Ruowang Tan
College of Mechanical and Electrical Engineering, Changchun University of Science and Technology, China

- Investigate the influence of different energy on micropore diameter
- Acoustic emission technology was used to acquire the preparation process in real time
- The close correlation between AE signal and microtexture surface was established

Preparation of Bionic Anisotropic Super-hydrophobic Surface Based on Ti6Al4V Alloy

Donghui Chen, Bo Wang, Xiao Yang, Menghua Zhong
Key Laboratory of Bionic Engineering (Ministry of Education), College of Biological and Agricultural Engineering, Jilin University, China

- The micro/nano structures and anisotropic wettability of indocalamus leaves were studied in detail.
- An indocalamus-inspired bionic anisotropic super-hydrophobic surface was fabricated on Ti6Al4V by nano-second laser.
- The mechanism of anisotropic wettability on the super-hydrophobic surface was proposed.


Jiaqi Wang
Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing, Changchun University of Science and Technology, China

- the micro-gear in WJAL exhibited a smaller size of heat-affected zone (HAZ) and the few accumulation of molten material
- The micro-gear in WJAL reported the high yield strength and yield strength.
- the micro-gear in WJAL had stronger corrosion resistance than micro-gear in LD in a 3.5% sodium chloride solution
- the WJAL could be utilized in fabrication of micro parts of difficult-to-process materials with high quality and performance
Biomimetic Technology of Mechanical Sensing Based on Biological Microcrack Receptors
Guangjun Chen, Zhiwu Han
1. Key Laboratory of Bionics Engineering of Ministry of Education, Jilin University
2. Ministry of Education Key Laboratory for Cross-Scale Micro and Nano Manufacturing, Changchun University of Science and Technology, China

- Morphology characterization and material properties of microvibration receptors.
- Mechanical properties and mechanism of functional structure of microvibration receptors.
- Fabrication of biomimetic sensors inspired by microvibrational receptor materials.

Modeling and analysis of discharge process in electrical discharge machining of NiTi shape memory alloys
Yonggang Hou
School of Mechanical Engineering
Anhui University of Science & Technology, China

- The sparse continuous discharge method is adopted to establish the empirical formula of the discharge channel radius for WEDM.
- The influence of discharge current and pulse width on discharge channel is clarified.
- The numerical model of the WEDM is established, where the formation process of the surface pit and recast layer of the discharge processing material is specified.
44-1 10:20–10:32

Design and analysis of large-stroke high-precision compliant attitude regulator for Micro-LED laser transfer

Yingjie Jia
Electromechanical engineering, Guangdong University of Technology, China

- A large-stroke high-precision spatial attitude regulator based on flexure is proposed for MicroLED laser transfer.
- A lever-bridge hybrid displacement amplification mechanism (LBDAM) with large displacement amplification ratio and high positioning accuracy is designed innovatively.
- The experimental system of spatial attitude regulator is established to validate the effectiveness.

44-2 10:32–10:44

Hollow Mo₂C Nanofibers Improve the Electrochemical Performance of Lithium-Sulfur Battery Cathode

Bin Yue
School of Materials Science and Engineering, Changchun University of Science and Technology, China

- In summary, hollow carbon nanofibers loaded with Mo₂C are successfully synthesized using coaxial electrospinning technology and applied as a matrix material for Li-S batteries. The composite cathode exhibits a specific capacity of 904 mAh g⁻¹ at 0.2 C. The composite cathode maintained a reversible capacity of 573 mAh g⁻¹ after 200 cycles, with a capacity loss rate of 0.18% per cycle. This study presents a novel approach to efficiently and cost-effectively synthesize matrix materials for Li-S batteries.

44-3 10:44–10:56

Conjugation electro-spinning toward Janus-like micro-fibers array displaying magnetic-bule fluorescent-conductive aeolotropism

Yaolin Hu
School of Materials Science and Engineering, Changchun University of Science and Technology, China

- Magnetic-fluorescent-anisotropic conductive Janus-like micro-fiber arrayed film is designed and prepared by conjugated electrospinning.
- Partition of two independent domains in Janus-like micro-fiber is microscopically realized.
- Strategy and technique are extended to build other anisotropic conductive films and multi-functional materials.
### A Single-Molecule Manipulation Instrument Integrated with In Situ Nanopore Fabrication

Bohua Yin  
International Research Centre for Nano Handling and Manufacturing of China, Changchun University of Science and Technology, China

- The instrument performs in situ nanopore fabrication and single molecule manipulation in a seamless way.
- The instrument can fabricate a nanopore within 5 s in a trackable location.
- The instrument permits the control of DNA exits the nanopore with single nucleotide precision.

### Manipulating nanoscale drilling machines based on nested carbon nanotubes through coding strategies

Haonan Chen  
School of Mechanical Engineering, Southeast University, China

- Proposing a new nano scale drilling rig model.
- By switching surface charges, nanoscale drilling machines can be regulated.
- Analyzed the displacement, velocity, and acceleration during the operation of nanoscale drilling rigs.

### A Novel Cross-flow Wood Filter for Efficient Water Treatment

Tong Su, Gensheng Wu*, Weiyu Chen, Jianjun Xie, Bo Yu  
College of Mechanical and Electronic Engineering, Nanjing Forestry University, China

- A cross-flow wood filter for water treatment is constructed by carving rectangular grooves on natural basswood.
- Superior water treatment effect is acquired without sacrificing the flow rates in the cross-flow filter.
- The hierarchical 3D structure in cross-flow wood filter provides a clue for efficient water treatment.
- The design of this cross-flow wood filter provides an available platform in the wastewater treatment field.
Controlling DNA Capture by Electroosmotic Flow of Oppositely Charged Nanopores

Xiaojing Lin, Wei Si
Jiangsu Key Laboratory for Design and Manufacture of Micro-Nano Biomedical Instruments, School of Mechanical Engineering, Southeast University, Nanjing

- Use opposite charged nanopore to capture ssDNA into the positively charged nanopore
- Explore the ionic current of the whole system during the capture progress
- Reveal the mechanism behind the capture is the distribution of different potentials causes strong electroosmotic flow
- Achieve the purpose of sequencing or molecular sieve

M/LDH-enhanced Laser Desorption/Ionization Mass Spectrometry for Metabolite Screening

Chunmeng Ding
School of Biomedical Engineering, Shanghai Jiao Tong University, China

- The surface-modified M/layered double hydroxides (LDHs) were synthesized via an ultrasound-assisted method.
- The M/LDHs have a good performance in small metabolite detection using LDI MS.
- M/LDH-enhanced LDI MS has broad prospects in applications for metabolite screening, disease diagnosis, etc.

Metasurface-based miniaturized and simplified two-photon lithography system

Xinger Wang, Xuhao Fan, Yuncheng Liu, Ke Xu, Hui Gao*, Wei Xiong*
Wuhan National Laboratory for Optoelectronics, Huazhong University of Science and Technology, China

- Metasurface is used to replace objective lens and other modules of the traditional system.
- Compared to single focus manufacturing, the processing throughput is increased by 7 times.
- The processing uniformity of each focus meets the actual demand.
- It has driven the dramatic miniaturization and cost reduction of two-photon lithography system.
Ferroelectric-integrated Graphene Plasmonic Device For Tunable Terahertz Detection
Lin Lin¹, Shicai Wang², Wen Huang²
Inst Funda & Fronti Sci, Univ Elect Sci & Technol China, China
Elect Sci & Engr, Univ Elect Sci & Technol China, China

• Graphene surface plasmon polaritons induced by polarized ferroelectric domains for terahertz detection
• Tunable absorption from ~5 to ~8 THz with high responsivity (1717 A/W) and detectivity (1.07×10¹³ Jones).
• Promising for spectrum reconstruction application of portable spectrometer combining the mathematical algorithms

Notes:
## Pseudocapacitive sodium-ion storage toward high-rate applications

Qiulong Wei  
College of Materials, Xiamen University, China

- Sodium-ion storage technologies are promising candidates for large-scale grid systems.  
- The surface-redox properties of TiO$_2$(A) result in excellent rate capability, cycling stability and low overpotentials.  
- Tailoring the surface-redox mechanism represents a promising direction for high-power sodium-ion storage.

## High-Resolution Electrochemical Techniques for Studying Electrocatalysis

Zhaoyu Jin  
Institute of Fundamental and Frontier Sciences, University of Electronic Science and Technology of China, China

- High-resolution electrochemical techniques for model catalytic systems are demonstrated.  
- Atom-by-atom electrodeposition strategy reveals size effects on oxygen evolution reaction.  
- Surface interrogation scanning electrochemical microscopy allows the measurement of single-atom site density and reactivity.  
- Reaction kinetics and mechanisms in ammonia electrosynthesis are probed with scanning electrochemical microscopy.

## Aqueous zinc-based batteries based on conversion reaction cathodes

Chunlong Dai  
College of Materials Science and Engineering, Sichuan University, China

- Aqueous zinc-based batteries based on ion intercalation/extraction reaction mechanisms deliver low specific capacity  
- We explore sulfur and selenium as the cathode for aqueous zinc batteries, and both show high specific capacity  
- We propose an aqueous zinc-based cascade battery  
- We propose a dual-plating strategy to fast construct micro-batteries
Design and applications of flexible thermal-electricity conversion systems
Tianpeng Ding
School of Physics, University of Electronic Science and Technology of China, China

1. P/n alternating TE fibers are fabricated in a scalable method.
2. TE fabric is weaved using p/n alternating TE fibers.
3. TE fabric is capable of wearable thermal energy harvesting.

Structural Chemistry of magnetic MAX phases
Youbing Li
School of Radiation Medicine and Protection, Soochow University, China

- A-site single-atom-thick two-dimensional iron layers realizing in the Mn+/AXn phases
- Room temperature ferromagnetic
- Synergistic effect of dielectric and magnetic loss

PNAS 17, 820 (2020); Appl. Phys. Rev. 8, 031418 (2021); Adv. Sci. 10, 2206877 (2023)
Technical Session 46
Nanometrology and Characterization
Room 7
10:20-12:20 Thursday, 3 August
Chair: Yayun Pu
Co-Chair: Xiang Lv

46-1  10:20–10:32

**Electrochemical Monitoring of Intracellular ROS Based on Automated Nanoprobe Platform**

Yanmei Ma, Weikang Hu, Muyang Ruan, Zhen Zhan, Yi Zhang, Chengzhi Hu*

Department of Mechanical and Energy Engineering, Southern University of Science and Technology, China.

- Precise electrochemical sensing of intracellular ROS/RNS based on automated nanoprobe platform.
- Label-free and high throughput extraction of mitochondria.
- Maintain high cell viability with flexible control of probe speed, depth, and position.
- Provide an efficient and effective approach for label-free single-cell biopsies.

46-2  10:32–10:44

**Laser-induced Fluorescence Detection of CIRP Based on the Fluorescence Enhancement Effect of Photonic Crystal**

Ze Zhang

State Key Laboratory for Manufacturing Systems Engineering, Xi’an Jiaotong University, China

- Vertically deposited 300-nm SiO2 photonic crystal films with high uniformity.
- Annealing-induced blue shift and reduced reflection peak intensity.
- Optimal fluorescence enhancement at 45° incident angle and 520 nm emission wavelength.
- Linear correlation between fluorescence intensity and CIRP concentration, low detection limit.
- Promising for early liver cancer diagnosis.

46-3  10:44–10:56

**Distinguishing Single and Double Stranded DNA Based on Solid State Nanopores**

Xiaojing Hu

School of Mechanical Engineering, Southeast University, China

- Fabrication of nanopores using automated controlled breakdown.
- Single stranded DNA is driven through the nanopore by electro-osmosis.
- Double stranded DNA is driven through the nanopore by electrophoresis.
Single-molecule electrical characterization on a controllable-break-junction chip through electrostatic microactuators
Junyang Liu
College of Chemistry and Chemical Engineering, Xiamen University, China

- Molecular electronics aims to manufacture large-scale integrated circuits by using single molecules as electronic components.
- Mechanically Controllable break junction on microchips is currently used to construct single-molecule junctions with high stability.
- A MEMS-based single-molecule break junction system on a chip has been developed, simplifying traditional instruments.
- This device offers the potential for integrating single-molecule electronic devices onto chips.

Research on High Precision Automatic Sample Loading Device for Blood Analysis
Dong Li¹, Bo Liu¹, Jiao Meng²
1. Changchun GuoKesilai Science and Technology Ltd, Changchun, China
2. Suzhou Institute of Biomedical Engineering and Technology Chinese Academy of Sciences, Suzhou, China

- The sample loading device designed in this paper was composed of three parts including sampling module, robot arm system and turntable module, which directly carried out self-shaking, self-loading and incubation of blood samples in collecting vessels.
- The repeat alignment accuracy of the sample was ≤±50μm, and the loading speed was > 200mm/s. The loading speed of the robot arm was > 100mm/s.
- The accumulated error of the rotating disk was 80μm, which realized the automatic preparation of blood samples with 50 μl and antibody reagents with 20μl.

Body Fluids Identification by Nanoparticle Enhanced LDI MS
Yihan Wang
SMC, Shanghai Jiaotong University, China

- Obtaining metabolic fingerprinting of body fluids based on nanoparticle enhanced LDI MS.
- We conducted machine learning to identify body fluids (including serum, plasma, tear, and urine).
- A biomarker panel was developed for identifying four kinds of biofluids.
- Our work will facilitate the development of metabolomics identification for diverse body fluids towards rapid forensic application.
46-7  11:30–12:40
Additive manufacturing of metallic micro-nano structure via organic monomer chelated method
Tao Han, Chunsan Deng, Husace Hu, Songyan Xue, Hui Gao*, Wei Xiong*
School of Optics and Electronic Information
Huazhong University of Science and Technology, Wuhan, China
• High-precision complex 3D metallic micro-nano structure printing;
• Printing metallic micro-nano structure of different metal materials;
• Arrayed metallic micro-nano structures with high consistency on a large area;
• Manufacturing of alloy materials via organic monomer chelation.

46-8  11:40–11:50
Protein Identification through a Graphene Nanopore Powered by Electroosmosis
Jiayi Chen
School of Mechanical Engineering, Southeast University, China
• Research on protein sequencing technology is a crucial topic in life sciences and medicine subjects;
• Graphene membrane with a nanopore is considered to be an effective single molecule sensing;
• Electroosmosis could be the main power driving the translocation of a peptide;
• Facilitate accurate amino acid identification.

46-9  11:50–12:00
Improvement of the Mechanical Exfoliation Method to Prepare Impurity-free Few-Layer MoS$_2$
Yu Zhang, Yingjiao Zhai*, Jinhua Li, Wenhui Fang*
Nanophotonics and Biophotonics Key Laboratory of Jilin Province, Changchun University of Science and Technology, Changchun 130022, China
• Few-layer MoS$_2$ was prepared by a simple, inexpensive and environmentally friendly mechanical exfoliation method.
• The prepared MoS$_2$ exhibits excellent physical and optical properties.
• As a SERS substrate, the detection limit of R6G is $10^{-6}$ M, which verifies the wide potential application of this method in sensing.
Research on Automatic Micro-volume Liquid Pipetting Device in Flow Cytometer

Jiao Meng¹, Shihao Lu¹, Dong Li²*
1. Suzhou Institute of Biomedical Engineering and Technology Chinese Academy of Sciences, Suzhou, China
2. Changchun GuoKesilai Science and Technology Ltd, Changchun, China

• This paper developed the automatic micro-volume liquid pipetting device in flow cytometer according to the liquid volume requirements of the flow test reagent specification and combined with the instrument inspection process.
• The micro-volume liquid pipetting device designed in this paper is composed of manipulator control system, liquid path control and electric control system, within the pipetting range of 20µl-500µl, the accuracy is about 0.1µl, the coefficient of volume variation (CV) is less than 2%.

Analysis of Path Manipulation of Encoding Nanorobots

Zhendong Zhu, Wei Si
Jiangsu Key Laboratory for Design and Manufacture of Micro-Nano Biomedical Instruments, School of Mechanical Engineering, Southeast University, Nanjing

• U-shaped path design of multilayer graphene films.
• Accurate crawling of nanorobots along the path.
• MD simulation using VMD and NAMD2 software.
• Encoding the charges of atoms around the path to manipulate nanorobots.
• Accurate control in the range of hundreds of microns.
Special Session: Junior Researcher Education and Development Forum

Established in 2019 by a partnership between IEEE 3M-Nano International Conference and iBowu-JSA, Junior Researcher Education and Development Forum organizes a special session in the Conference, aiming to popularize the nanotechnology and interdisciplinary research among young students. The forum provides a platform for academically outstanding teenagers to demonstrate their participation in scientific research and to broaden their horizons by establishing scientific ideals.

The forum features presentations on original scientific research work conducted by teenagers who are actively involved in the cross section of physics, chemistry, molecular biology, bioinformatics and nanotechnology. Furthermore, the forum serves as a platform for the young talents to meet and learn from the world’s leading scientists.

About iBowu-JSA

Juvenile Science Academy (JSA) is the first scientific research academy for juniors in China, operated solely by the civil forces. JSA is initiated by iBowu, a domestic platform for youth scientific activities and academic research projects. JSA is aimed at providing Chinese young talents with high-quality scientific practice opportunities.

JSA received scientific support and capital investment from BGI and Good Future Education Industry Fund. With a strong scientific and capital background, JSA has assembled a cohort of top scientists working in a variety of multidisciplinary research fronts around the world, including China, the United States, Denmark, Norway, Singapore, Australia, etc. With the help of the scientists, we compiled joint laboratory resources from dozens of universities and research institutions in several countries for our future scientists. JSA provides students with state-of-the-art STEM research programs and elite training programs. We strive to cultivate the scientific spirit of Chinese youth, developing future scientific talents for China and for the global scientific and technological community.
Student Contributing Talks

Abstract: The substantial cost of new drug research and development has consistently posed a huge burden for both pharmaceutical companies and patients. In order to lower the expenditure and development failure rate, repurposing existing and approved drugs by identifying interactions between drug molecules and target proteins based on computational methods have gained growing attention. Here, we propose the DeepLPI, a novel deep learning-based model, to establish an end-to-end framework for protein–ligand interaction prediction. We first encode the raw ligand molecule and target protein into dense vector representations, which go through two ResNet-based 1D-CNN modules to derive features, respectively. The feature vectors are concatenated and further fed into the bi-LSTM network, followed by the MLP module to finally predict protein–ligand interaction. We train and test our DeepLPI on BindingDB and Davis datasets, and compared the performance with the baseline methods. The result that DeepLPI outperformed suggests the high accuracy of the DeepLPI towards protein–ligand interaction prediction. The high prediction performance of DeepLPI on the different datasets displayed its high capability of protein–ligand interaction in generalization, demonstrating that the DeepLPI has the potential to pinpoint new drug-target interactions and to find better destinations for proven drugs.

Maidou Wang
Duke University
Title: High Cellular Uptake Gene Delivery Platform with Chitosan and L-arginine Complex for Cancer Treatment

Abstract: Gene therapy outperforms chemotherapy in limiting the harm to human body. A major impediment to the progress of gene therapy is a lack of proper carriers. Chitosan, derived from shellfish, is a desirable candidate for nucleic acid delivery because of its outstanding biodegradability and biocompatibility. However, previous works show that chitosan has poor cell membrane permeability. In this study, we synthesize a complex delivery system for gene therapy by compounding chitosan with L-arginine, and test the encapsulation, uptake, and cancer cell treatment power. Encapsulation efficiency of the chitosan/L-arginine complex (CA) can reach more than 90% in weight. Flow cytometry reveal that siRNA delivered by the complex can be taken in by cells 10 times better than free siRNA and 2 times better than chitosan alone. Confocal imaging confirmed the high cellular uptake, and siRNA tests in HeLa cells indicate the successful silencing of the target gene (RRM2). The complex serves as a gene delivery system that is capable of loading and delivering a variety of genetic materials in which the specific nucleic acid molecule to be delivered could be altered at will.

Taiyuu Zhang
Beijing No. 8 High School
Title: Constructing Unextendible Product Bases from Multi-qubit Ones for Quantum Information

Abstract: Quantum information is a cutting-edge research and development frontier, involving multidisciplinary fields such as physics, mathematics, and information theory and technology. To study the fundamental concept of quantum entanglement in this field, one key task is to study the unextendible product basis (UPB), a key distinction between quantum and classical communications. In this theoretical investigation, we construct two families of UPBs of size eight by using the existing four-qubit and five-qubit UPBs, and applied these UPBs to study properties of novel families of entangled states in terms of the geometric measure of entanglement.
Title: Bio-Degradation of Pyrethroids: A Synthetic Biology Approach

Abstract: Pyrethroids are a class of pesticides that, despite their effectiveness in pest control, pose a significant threat to non-target organisms, including beneficial insects like bees and ants. Our project uses a synthetic biology approach to biodegrade pyrethroids, specifically addressing the harm they cause when accumulated in water bodies. We aim to develop a genetically modified organism capable of efficiently degrading these substances through surface expression of a carboxylesterase to breakdown pyrethroids in the environment, thereby reducing their impact on aquatic ecosystems and the larger environment. Degradation effectiveness of different classes of enzymes will be studied, as well as the specificity of the enzymes on different reagents in the pyrethroid family. Our project is not only a useful application of synthetic biology but also an opportunity to raise awareness about the importance of responsible pesticide use and the potential of synthetic biology to address environmental challenges.

Title: Harnessing Synthetic Biology for the Development of Titin Protein Fiber-Enhanced Artificial Heart Valves

Abstract: Our project explores the potential of synthetic biology in addressing the issue of improving the biocompatibility and mechanical strength of artificial heart valves. We are inspired by the inherent potential of the protein Titin, a protein that provides passive strength, damping capacity, and rapid mechanical recovery to muscle tissues. The recent advancements in synthetic biology have made it possible to engineer microbes for the production of high-performance polymeric materials. The microbial production of megadalton titin polymers has been demonstrated to yield high-performance fibers that exhibit a range of advantageous properties. These fibers not only recapitulate the highly desirable properties of natural titin but also display high strength, toughness, and damping energy, outperforming many synthetic and natural polymers. We hope that this application will illustrate the transformative potential of synthetic biology in addressing pressing issues in the field of biomedical engineering, especially those that can't be easily solved using conventional materials and methods.
**Zihao Dong**  
Peking Academy High School

**Tianjie Xu**  
RCF Experimental School

**Linda Geng**  
University of Carolina at Chapel Hill

**Chengkai Hu**  
Princeton International School of Math and Science

**Enshi Xu**  
iBowu-JSA

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**Title: Drug delivery of specific siRNA with nanomaterial carrier for cancer treatment.**

**Abstract:** siRNA represents a crucial therapeutic tool, capable of precisely targeting and degrading specific mRNA, thus preventing the production of certain proteins. However, siRNA is susceptible to enzymatic degradation in vivo and encounters difficulties penetrating the cell membrane. Utilizing LIPS as a nanocarrier can protect the siRNA, enhancing its stability within the organism, and facilitate its entry into cells. This experiment serves to validate the effectiveness of this delivery technology. Administering siRNA therapeutics into HeLa cells and mice using LIPS nanocarriers allows us to understand the response of cells and animals to siRNA therapeutics, encompassing the mechanism of drug action, toxicity, and potential side effects. This holds significant implications for optimizing drug design and selecting treatment strategies, as well as providing evidence for clinical trials.

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**Title: Examining Social Learning Behaviors in Cockroaches: An Operant Conditioning Experiment Reveals Evidence of Learning and Influence Among Individuals**

**Abstract:** Social learning is the behavior that one individual learns by intimating or observing other individuals in the same group. It is proven to exist among different species from insects to primates, such as learning about predation threats and food sources. However, a lot of studies showed that the social learning behaviors in insects, such as ants, bees, and flies, are different from that of mammals. They use different strategies to learn from others. Cockroaches are insects in the order Blattodea. Among around 4600 species, some cockroach species are highly connected with human habitats and are regarded as pests. They transport pathogenic microbes and are hard to eliminate. It is proved that cockroaches have learning behaviors based on the strong neuro system. Both classical conditioning and operant conditioning are been proven in previous research. However, there was no direct evidence on whether social learning behaviors exist in the group of cockroaches, the insects that co-live with human beings. To address this question, this study designed an operant conditioning behavior experiment to provide evidence of the existence of social learning behaviors among cockroaches. Our results show that after 5 training, cockroaches can learn how to distinguish the punishment and reward sides. After co-living with the well-trained cockroaches, the untrained cockroaches spent a significantly longer time on the reward side than the punishment side. This work contributes to the understanding of the social learning behaviors of cockroaches, and may further inspire novel methods regarding cockroach pest control and developing cockroach lures.

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**Title: Gene Editing with CRISPR to Create Genetic Spinal Disease Models in Zebrafish**

**Abstract:** Utilizing the CRISPR/Cas9 technology to knockout specific genes related to spinal cord development in zebrafish can significantly enhance our understanding of gene function. By observing the effects of such alterations on the development of zebrafish, we can gain a more comprehensive understanding of the specific roles these genes play in developmental processes. Moreover, this approach advances fundamental biological research by revealing intricacies across various stages, including cell proliferation, differentiation, and migration. Consequently, this enables the simulation of specific disease models for the profound investigation of drug screening and therapeutic strategies.
General Information

Overall

Chengdu, known as “Rong” for short and dubbed “Jin Guan Cheng”, has maintained its name since the Qin Dynasty over 2,000 years ago. Located in the southwest of China, Chengdu is the habitat of giant pandas. It is a fast-growing modern metropolis in China that follows Beijing and Shanghai, and the only megacity in the world that provides a view of snow-capped mountains 5,000 meters above sea level. Chengdu's culture largely reflects that of its province, Sichuan; in 2011, it was recognized by UNESCO as a city of gastronomy. It is associated with the giant panda, a Chinese national symbol, which inhabits the area of Sichuan; the city is home to the Chengdu Research Base of Giant Panda Breeding. Chengdu is now one of the most important economic, financial, commercial, cultural, transportation, and communication centers in China.

Prime location

Chengdu is located at the western edge of the Sichuan Basin and sits on the Chengdu Plain; the dominating terrain is plains. The vast plain on which Chengdu is located has an elevation ranging from 450 to 720 meters (1,480 to
2,360 feet). Northwest Chengdu is bordered by the high and steep Longmen Mountains in the north-west and in the west by the Qionglai Mountains, the elevation of which exceeds 3,000 m (9,800 ft) and includes Miao Jiling (5,364 m, 17,598 ft) and Xiling Snow Mountain (5,164 m, 16,942 ft). The western mountainous area is also home to a large primitive forest with abundant biological resources and a giant panda habitat. East of Chengdu stands the low Longquan Mountains and the west bordering area of the hilly land of middle reaches of Min River, an area noted by several converging rivers. Since ancient times, Chengdu has been known as "the Abundant Land" owing to its fertile soil, favorable climate, and novel Dujiangyan Irrigation System.

**Literature**

Some of China's most important literature comes from Chengdu. The city has been home to literary giants, such as Sima Xiangru and Yang Xiong, two masters of Fu, a mixture of descriptive prose and verse during the Tang dynasty; Li Bai and Du Fu, the most eminent poets of the Tang and Song dynasties respectively; Yang Shen'an, a famous scholar of the Ming dynasty; and Guo Moruo and Ba Jin, two well-known modern writers. Chang Qu, a historian of Chengdu during the Jin dynasty, compiled the earliest local historical records, the Record of Hua Yang State. Zhao Chongzuo, a poet in Chengdu during the Later Shu Kingdom, edited Among the Flowers, the first anthology of Ci in
China's history. Meng Chang, the king of Later Shu, wrote the first couplet for the Spring Festival, which says, "A harvest year accepts celebrations, good festivals foreshadow long springs." In 2023, Chengdu will host the 81st World Science Fiction Convention, having beat out Winnipeg, Canada, in site-selection voting in 2021.

**Fine Art**

During the period of the Five Dynasties, Huang Quan, a painter in Chengdu, initiated the Fine-Brush Flower-and-Bird Painting school with other painters. At that time, "Hanlin Painting Academy" was the earliest royal academy in China.

**Theater**

**Sichuan Opera**

The saying "Shu opera towers above all other performances in the world" reflects the achievement of Sichuan opera and Zaju (an ancient form of comedic drama involving dancing, singing, poetry, and miming). In the city, the first named opera "Bullfighting" was written in the Warring States Period. [clarification needed] The first detailed recorded opera was staged in the royal court of Shu Kingdom during the Three Kingdom Period. China's first clearly recorded Zaju was also performed in Chengdu. Tombs of witty Han dynasty
Culinary art and tea culture

Culinary Art

The distinct characteristic of Sichuan cuisine is the use of spicy chilies and peppercorns. Famous local dishes include Mapo doufu, Chengdu Hot pot, and Dan Dan Mien. Both Mapo Doufu and Dan Dan Mien contain Sichuan peppers. An article by the Los Angeles Times (2006) called Chengdu "China's party city" for its carefree lifestyle. Chengdu has more tea houses and bars than Shanghai despite having less than half the population. Chengdu's tea culture dates back over a thousand years, including its time as the starting point of the Southern Silk Road. Common side dishes popular in Chengdu include noodles, wontons, dumplings, pastries, tangyuan (sweet rice balls), drinks, salads and soups.

Hot pot is a traditional Sichuanese dish, made by cooking vegetables, fish, and/or meat in boiling spicy broth. A type of food suitable for friends' gathering, hot pot attracts both local people and tourists. Hot pot restaurants can be found everywhere in Chengdu. Chengdu is an officially recognised UNESCO City of Gastronomy.
Teahouse

Tea houses are ubiquitous in the city and range from ornate traditional establishments with bamboo furniture to simple modern tea houses. Teas on offer include jasmine, longjing and biluochun tea. Tea houses are popular venues for playing mahjong, getting a massage or one's ears clean. Some larger tea houses offer live entertainment such as Sichuan opera performances.
Contact Information

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Changchun University of Science and Technology
7089 Weixing Road, Chaoyang District, Changchun, China, 130022

Conference Venue

All sessions will be held at Chengdu Homeland Hotel
Address: 181 Jichang Road, Chengdu, China

Electricity

The electric current used in China is 220V 50Hz. The hotels can provide
220V power outlets. Please note that plug adapters may be necessary.

Dialing Codes

China International Country Code: +86
Chengdu’s Local Area Code: 028
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