The Diamond Workshop at IMR

Organizer:

Shenyang National Laboratory for Materials Science

Institute of Metal Research, Chinese Academy of Sciences

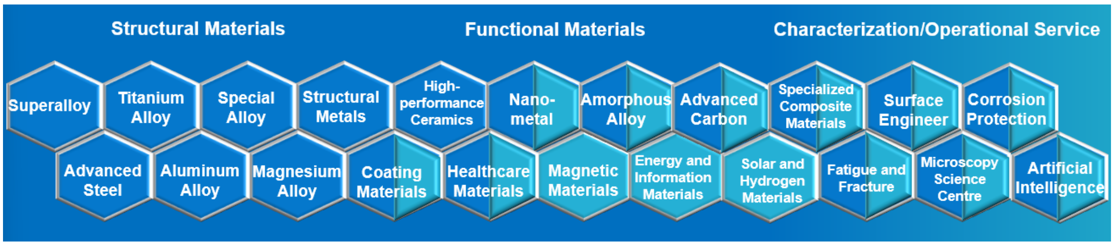
Wenhua Road 72, Shenyang, China

11-13, June 2026

Institute

The **Institute of Metal Research (IMR)**, **Chinese Academy of Sciences (CAS)** was founded in 1953 as one of the first research institutes established by CAS after the founding of the People's Republic of China. Since then, IMR has firmly established itself as an indispensable base for the research and development of materials science and engineering in China.

IMR has conducted comprehensive research covering advanced structural materials—such as superalloys, titanium alloys, special alloys, high performance steels, aluminum alloys, magnesium alloys, metal matrix composites, and ceramics—as well as novel functional materials including nanomaterials, carbon materials, magnetic materials, biomaterials, and energy materials. Its research encompasses material composition design, structural characterization, processing and fabrication, performance testing, and service behavior studies.



IMR has gathered to gether outstanding scientists and technical experts in the field of materials research. IMR has more than 1900 staff, including 7 members of Chinese Academy of Sciences and the Chinese Academy of Engineering. IMR scientists are actively involved in widely international academic affairs. Among them, 11 scientists serve in 15 international academic organizations and 65 scientists serve academic positions in 58 international journals.

IMR is one of the first organizations authorized to confer doctoral degrees in materials science and engineering in China. In 2015, IMR collaborated with the University of Science and Technology of China to establish the School of Materials Science and Engineering, dedicated to cultivating future leaders in the field of materials. Currently, IMR has an enrollment of more than 1400 graduate students who have the opportunity to engage with cutting-edge developments in materials science, participate in major research projects, and hone their research skills and innovative capabilities through hands-on scientific practice.

The Diamond Workshop at IMR

The **Diamond Workshop at IMR** will be held during 11-13, June 2026 at the Institute of Metal Research, Chinese Academy of Sciences in Shenyang, Liaoning Province, China. The conference will bring together industry experts and academics from both China and abroad to discuss advanced manufacturing technologies for diamond materials and their applications in fields such as quantum information, biosensing, energy, environment, etc.

Timeline:

<table>
<tr><th>Time</th><th>June 11</th><th>June 12</th><th>June 13</th></tr>
<tr><td>09：00 — 12：00</td><td rowspan="3">Registration
Swissotel Hotel
Shenyang</td><td>Invited presentation</td><td rowspan="2">Laboratory Tour
Discussion</td></tr>
<tr><td>12：00 — 14：00</td><td>Lunch</td></tr>
<tr><td>14：00 — 18：00</td><td>Invited presentation</td><td rowspan="2">Discussion
Departure</td></tr>
<tr><td>18：00 — 20：00</td><td>Buffet</td><td>Banquet</td></tr>
</table>

Workshop Place:

Room 310, Kuo Ke-Hsin Building

Institute of Metal Research, Chinese Academy of Sciences

No.72 Wenhua Road, Shenyang 110016, China

Organizer:

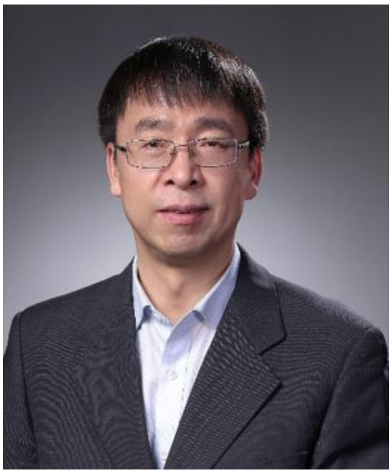
Shenyang National Laboratory for Materials Science, Institute of Metal Research, Chinese Academy of Sciences

Organizer Commitee:

Prof. Chang Liu (Institute of Metal Research, Chinese Academy of Sciences, China)

Prof. Nianjun Yang (Hasselt University, Belgium)

Prof. Nan Huang (Institute of Metal Research, Chinese Academy of Sciences, China)



Prof. Chang Liu

Prof. Nianjun Yang

Prof. Nan Huang

Registration:

There is no registration fee for the conference.

Contact:

Prof. Lusheng Liu	Email：lsliu@imr.ac.cn	Tel：18609816267
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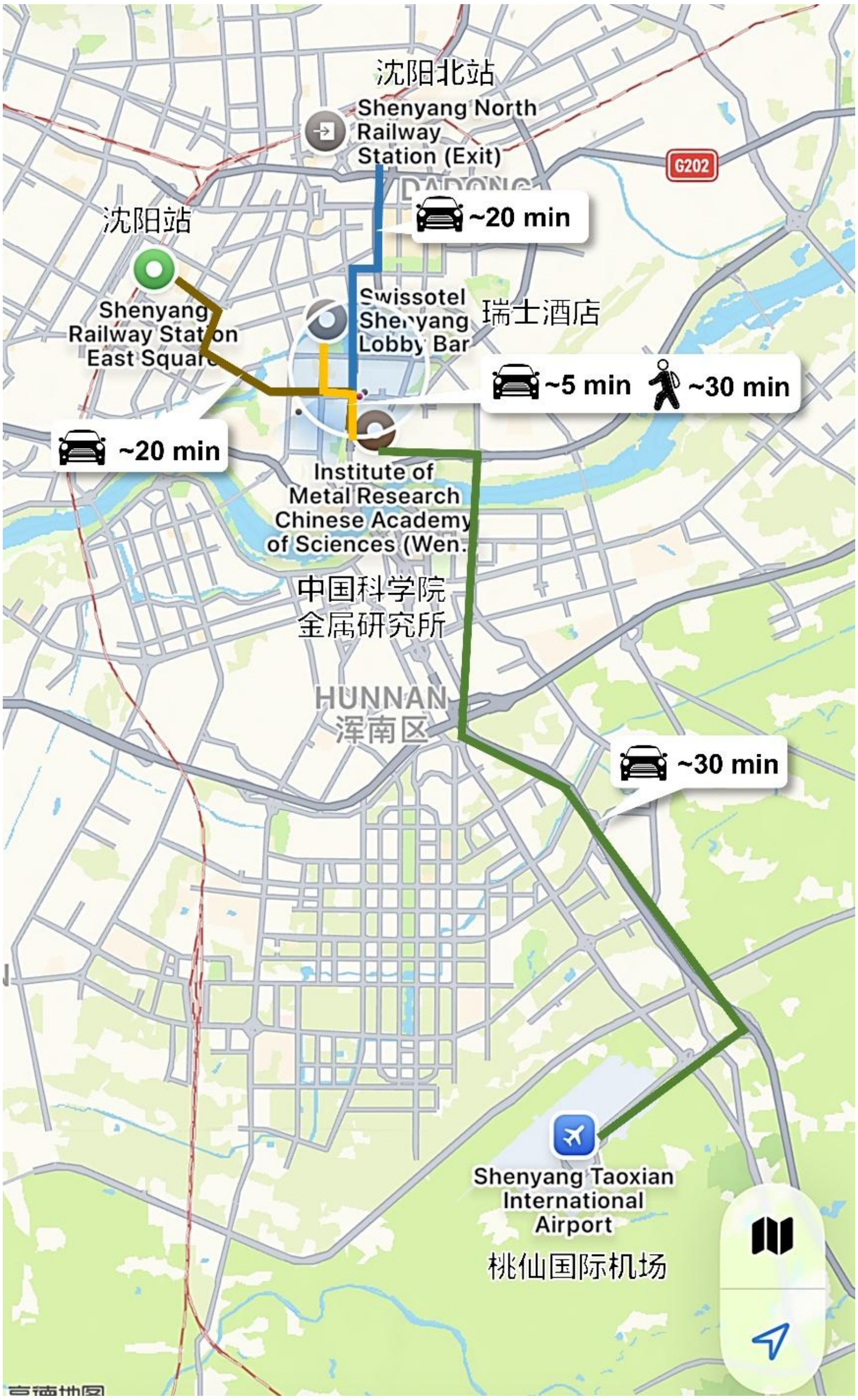
Dr. Chuyan Zhang	Email：cyzhang@imr.ac.cn	Tel：13897910506
Dr. Bin Chen	Email：bchen18s@imr.ac.cn	Tel：15856964955

Invited speakers (Last name in alphabet order):

Name	Institute
Chia-Liang Cheng	Dong Hwa University
Ken Haenen	Hasselt University
Xiaojun Hu	Zhejiang University of Technology
Hiroshi Kawarada	Waseda University
Naoki Komatsu	Kyoto University
Quan Li	The Chinese University of Hong Kong
Jianbo Liang	National Innovation Center for Third-Generation Semiconductor Technology (Suzhou)
Meiyong Liao	National Institute of Materials Science
Bingbing Liu	Jilin University
Jinlong Liu Chengming Li	University of Science and Technology Beijing
Anmin Nie	Yanshan University
Hong-Xing Wang	Xi'an Jiaotong University
Mingguang Yao	Jilin University
Haitao Ye	Fudan University
Jiaqi Zhu	Harbin Institute of Technology

Accommodation:

Swissotel Hotel Shenyang，No.108 Qingnian Street, Shenyang Tel: +86 024 2298 8888



Program

June 12 Friday morning

Session I (9:00-11:00) (Place: Room 310, Kuo Ke-Hsin Building**)**		
9:00-9:10	Opening Speech	
Chair: Chang Liu		
9:10-9:30	Hiroshi Kawarada (Waseda University)	H-terminated Diamond Surface as Natural Inversion Layer
9:30-9:50	Bingbing Liu (Jilin University)	High-Pressure Artificial Synthesis of Hexagonal Diamond
9:50-10:10	Ken Haenen (Hasselt university)	GeV and SnV Centres in CVD Diamond: From Microstructure and Strain to Photoluminescence
10:10-10:30	Anmin Nie (Yanshan university)	Superhard Materials: Micromechanics and Near-Atomic-Scale Cutting
10:30-11:00	**Coffee Break, Poster Discussion**	
Session II (11:00-12:10) (Place: Room 310, Kuo Ke-Hsin Building**)**		
Chair: Nianjun Yang		
11:00-11:20	Naoki Komatsu (Kyoto University)	Advantages of Nanodiamond for Biomedical Research
11:20-11:40	Jiaqi Zhu (Harbin Institute of Technology)	High-quality Diamond Growth & Semiconductor Applications
11:40-12:00	Jinlong Liu, Chengming Li (University of Science and Technology Beijing)	Pulsed-Modulated Plasma Preparation of High-Strength and High-Hardness Diamond Films
12:00-12:10	**Group Photo**	
Lunch (12:10-13:00: 3rd floor of the canteen at IMR)		
13:00-14:00: Tour of the Institute and Lab		

June 12 Friday afternoon

Session III (14:00-16:10) (Place: Room 310, Kuo Ke-Hsin Building)		
Chair: Nan Huang		
14:00-14:20	Meiyong Liao (National Institute for Materials Science)	Diamond MEMS beyond Mechanics
14:20-14:40	Hong-Xing Wang (Xi'an Jiaotong University)	Progress of Diamond Material and Its Application
14:40-15:00	Xiaojun Hu (Zhejiang University of Technology)	Ordinary-Pressure Phase Transformation from Graphite to Diamond
15:00-15:20	Chia-Liang Cheng (Dong Hwa University)	The Biomedical Applications of Nanodiamond
15:20-15:40	Haitao Ye (Fudan University)	Corrosion Behaviour of Boron-doped Diamond Coatings
15:40-16:10	**Coffee Break, Poster Discussion**	
Session IV (16:10-17:30) (Place: Room 310, Kuo Ke-Hsin Building)		
Chair: Nianjun Yang		
16:10-16:30	Quan Li (The Chinese University of Hong Kong)	In operando Nanothermometry in Electrocatalytic Devices by Nanodiamond Sensors
16:30-16:50	Mingguang Yao (Jilin University)	Paracrystalline Graphite from High Pressure
16:50-17:10	Jianbo Liang (Suzhou Institute of Advanced Semiconductor Technology)	Room-Temperature Direct Bonding of GaN and Diamond Toward Advanced Thermal Management of High-Power Electronics
17:10-17:30	Nan Huang (Institute of Metal Research, Chinese Academy of Sciences)	Growth and Applications of Novel Diamond Materials
Bus to Swissotel Hotel，18:30 Banquet: Swissotel Hotel		

Invited speakers

Prof. Hiroshi Kawarada received Doctor of Engineering from Waseda University (1985) and joined Osaka University as Assistant Professor (1986) where he started diamond research. Later, he worked in Waseda University as Associate Professor (1990) and Professor (1995-), where he invented H-terminated diamond FETs in 1994. As Visiting Researcher he stayed in Fraunhofer Institute (IAF) by Fellowship of Alexander von Humboldt Foundation (1995-1996). As an organizer he served for European Conference on Diamond and Related Materials (1998-2008). In Japan, he also served for Japan Applied Physics Society as Board Member, New Diamond Forum as Chairman (2009-2014) and Science Council of Japan as Member. He has received the Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology (MEXT), Research Category (2016) and Fellow Award, Japan Society of Applied Physics (2010). His research field is nanoelectronics, bioelectronics and power & high frequency electronics using diamond, where he has pure reviewed 410 articles with 12,000 citations and h-index 59 (Scopus), 16,000 citations and h-index 69 (Google Scholar)

Topic: H-terminated Diamond Surface as Natural Inversion Layer

Name/Title: Prof. Hiroshi Kawarada

Institute: Research Organization for Nano & Life Innovation, Waseda University

Abstract:

1. Extremely low Schottky barrier height at Au/H-terminated diamond [1]

Because of the wide bandgap of diamond (5.5 eV), it has long been assumed that both electron and hole Schottky barriers are large. On hydrogen-terminated (H-terminated) surfaces, however, Ohmic contacts can be easily achieved by utilizing metals with high work functions, such as Au. In contrast, Al, which has a low work function, forms a Schottky diode with a barrier height of 0.6 to 0.7 eV on the same H-terminated surface [1].This trend in barrier height implies that it depends on the work function (or electronegativity) of the metal, indicating an extremely low surface state density—a stark contrast to the problematic surface states found in Ge and Si. As expected from the negative electron affinity of C–H diamond, the hole barrier height Φ_{bp} becomes smaller than that of a clean or C–O surface. The hole barrier Φ_{bp} is expressed as: $\Phi_{bp} = E_G + \chi_S - \Phi_m$

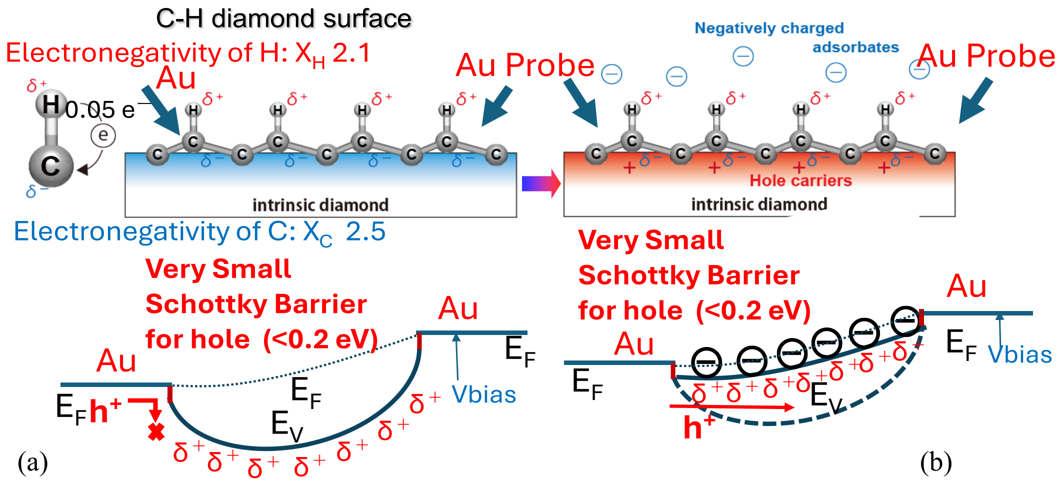
Assuming $\chi_S = -0.5$ eV in an ideal interface Schottky model with a negligible density of surface states, substituting the work function of Au ($\Phi_m = 5.0$ eV) yields $\Phi_{bp} \sim 0$ eV, effectively eliminating hole barrier. Such a phenomenon is extremely special for a wide-bandgap semiconductor.

2. Inversion layer by negative charge between ohmic contacts [2]

Between one Ohmic contact and the other in Fig.1(a), the energy band bends downward in a concave shape the surface positive charge of H-terminated surface by electron transfer from H atoms to C atoms, forming a potential barrier for hole conduction and obstructing their transport. For hole conduction to take place, the concave potential must become nearly linear (Fig. 1(b)). This can be achieved by a potential rise induced

either by negative charges or by a negative bias voltage. On a clean H-terminated surface without adsorbates, negative ion irradiation increases the p-type conductivity by several orders of magnitude [2]. Furthermore, in a MISFET with a clean C–H surface channel, 2DHG conduction is induced by applying a negative voltage. The author believes these results demonstrate the p-type conduction effect induced by negative charges. Considering semiconductor physics, it may be more appropriate to describe this phenomenon as a p-type inversion layer induced by ions or defects, when nitrogen (donor) concentration in bulk is higher than that of boron (acceptor) [2].

1) H. Kawarada, Surface Science Reports **26**, 205 (1996).
2) H. Kawarada, J. Phys. D (topical review) **56**, 053001 (2023).



(a) (b)

Fig.1 Atomic arrangement and correspoindingbvalence band diagram of H-terminated diamond with two Au ohmic contacts. (a) clean. (b) with negatively charged adsorbates [2].

Prof. Bingbing Liu is a full professor and Director of the State Key Laboratory of High Pressure and Superhard Materials at Jilin University. She concurrently serves as the executive chief scientist of the "High-Temperature and High-Pressure Large-Volume Material Research System," a subsystem of the Synergetic Extreme Condition User Facility (SECUF)., She has long been dedicated to fundamental research in high-pressure materials and the development of ultra-high-pressure technology. She has published over 400 papers in journals such as Nature andScience. Her individual honors include the Wiley Women in Research Award, the Xie Xide Physics Award, and the China Young Women Scientist Award. She also serves as the Vice Chair of the Superhard Materials Committee of the Chinese Materials Research Society, and Chair of the Light Scattering Committee and the Vice Chair of the High Pressure Physics Committee of the Chinese Physical Society.

Topic: High-Pressure Artificial Synthesis of Hexagonal Diamond

Name/Title: Prof. Bingbing Liu

Institute: State Key Laboratory of High Pressure and Superhard Materials , Jilin University

Abstract:

Hexagonal diamond—a rare meteoritic carbon phase with hexagonal structure was found decades ago. However the independent existence and pure phase remained contentious due to its higher formation energy barrier compared to cubic diamond. Here, we present two innovative strategies for synthesizing near-pure hexagonal diamond: First, through in situ diamond anvil cell, we identified a new general pathway where graphite transforms into hexagonal diamond via “post-graphite phase” upon heating, applicable to both single-crystal and nanoscale graphite precursors. By integrating a self-developed large-volume press with thermally heterogeneous assemblies, we exploited temperature gradients under pressure to achieve the first bulk synthesis of high-quality hexagonal diamond. Second, a novel high-pressure assembly incorporating uniaxial force enabled the conversion of HOPG into pure-phase, millimeter-sized hexagonal diamond at relatively lower pressure. The hexagonal diamond exhibits a hardness exceeding natural cubic diamond by >40% and wide bandgap. These breakthroughs establish effective routes for the fabrication of hexagonal diamond, expanding the family of superhard materials and offering a promising candidate in the application of wide band semiconductor.

Prof. Dr Ken Haenen, FMRS, is a full professor of experimental physics at Hasselt University, Belgium, where he is also Vice-Rector for Research, Valorisation, and Internationalisation. He obtained his PhD in physics from Hasselt University in 2002 and, after postdoctoral research including a stay at the National Institute for Materials Science in Tsukuba, Japan, was appointed to a tenure-track position in 2008 and became full professor in 2019. He leads the Wide Band Gap Materials research group at the Institute for Materials Research (IUMAT; a joint Hasselt University and imec research institute), with a strong focus on the chemical vapour deposition, doping, characterisation, and functional integration of diamond and related wide-bandgap materials. His research covers single-crystal and nanocrystalline CVD diamond for power electronics, dopant engineering, quantum defects, membrane structures, electrochemical interfaces, and biohybrid diamond systems. Prof. Haenen has authored over 280 peer-reviewed journal publications. He is Editor-in-Chief of *Diamond and Related Materials*, Section Editor of *MethodsX* in Materials Science, and serves on the editorial boards of journals including *Scientific Reports* and *physica status solidi*. He is a Fellow of the Materials Research Society, recognised for sustained leadership in diamond and carbon research, impactful editorial stewardship, and long-term service to the global materials science community. He continues to play an active role in MRS, both as a Symposium Organiser and as Chair of the Program Development Subcommittee. Prof. Haenen is also deeply involved in the international diamond and nanocarbon community, including through the organisation of the Hasselt Diamond Workshop (SBDD) and the International Conference on Diamond and Carbon Materials (ICDCM), and serves as Executive Committee Chair of the International Conference on New Diamond and Nano Carbons (NDNC).

Topic: GeV and SnV Centres in CVD Diamond: From Microstructure and Strain to Photoluminescence

Name/Title: Prof. Ken Haenen

Institute: Institute for Materials Research (IUMAT), Hasselt University

Abstract:

Group-IV vacancy centres in diamond, such as germanium-vacancy and tin-vacancy centres, are attracting increasing interest for quantum sensing and photonic applications. Their optical properties, however, are strongly influenced by the local crystal environment, making controlled fabrication during chemical vapour deposition a central challenge.

This invited talk will discuss recent work on the in-situ formation of GeV and SnV centres in CVD diamond. Particular attention will be given to how growth conditions, dopant source, microstructure and residual strain affect photoluminescence. GeV centres in nanocrystalline diamond will be used to illustrate the relation between film structure, strain-induced shifts and splitting of the zero-phonon line, while recent SnV studies will highlight the opportunities and challenges of incorporating heavy group-IV elements during growth.

By linking colour-centre fabrication to microstructure and strain control in CVD diamond films, the presentation will show how strain can be understood not only as a complication, but also as a diagnostic and potentially useful design parameter for tailoring optical emission in diamond-based quantum and photonic materials.

Prof. Anmin Nie is a full professor at State Key Laboratory of Metastable Materials Science and Technology, Yanshan University, China. He specializes in developing and applying in-situ high-resolution transmission electron microscopy techniques. His research focuses on designing in-situ mechanical devices, exploring the micro-nano mechanics of superhard materials, and understanding structure-property relationships. Dr. Nie has pioneered an experimental platform for in-situ micro-nano mechanical testing of materials with strong covalent bonds. This platform allows for precise measurement of the mechanical properties of diamond and real-time observation of microstructural evolution. He has published over 200 papers in prestigious journals, including Nature Materials, Nature Nanotechnology, and Matter.

Topic: Superhard Materials: Micromechanics and Near-Atomic-Scale Cutting

Name/Title: Prof. Anmin Nie

Institute: State Key Laboratory of Metastable Materials Science and Technology, Yanshan University

Abstract:

This presentation explores the micro-mechanical behavior of superhard materials and its application in near-atomic-scale cutting. A key starting point is the development of a micro/nano-mechanical testing method for superhard materials, which enables direct investigation of their deformation at extreme small scales. Using this approach, single-crystal diamond nanopillars were bent close to the theoretical elastic limit, while room-temperature dislocation plasticity and anomalous non-close-packed slip were observed. Based on these findings, a strategy for activating deformation twinning in diamond and cBN single crystals was established by considering the competition among non-close-packed slip systems. High-density deformation twins were achieved experimentally, and a new cooperative-shear-induced twinning mechanism was identified in cBN. These insights further enabled the fabrication of ultra-sharp single-crystal micro/nano tools using FIB and cleavage along the (111) plane. Finally, near-atomic-scale cutting of metallic materials was realized, revealing material removal behaviors distinct from conventional cutting.

Naoki Komatsu received his bachelor's, master's and doctor's degrees from Kyoto University in 1986, 1988 and 1993, respectively. He joined Okayama University in 1993 and moved to Kyoto University as Assistant Professor in 1994. In 1997, he worked at Florida State University as a visiting scholar for one year. In 2003, he moved from Kyoto University to Shiga University of Medical Science as Associate Professor. He was promoted to Professor at Kyoto University in 2015. His research concept is to "apply organic chemistry to nanomaterials" including supramolecular chemistry for structural separation of nanocarbons and synthetic organic chemistry on inorganic nanoparticles for cancer nanomedicine. He is also a cofounder and board member of the start-up, RadioNano Therapeutics Inc. which was founded in Apr. 2024.

Topic: Advantages of Nanodiamond for Biomedical Research

Name/Title: Prof. Naoki Komatsu

Institute: Graduate School of Human and Environmental Studies, Kyoto University

Abstract:

We have been working with nanodiamond for biomedical research. For the purpose, we have to functionalize it to impart the various functions such as high aqueous dispersibility, high stealth efficiency, and high targeting capability. From the viewpoints, I would like to summarize the advantage of nanodiamond in terms of size separation [1,2], chemical functionalization [2,3] qualitative and quantitative characterization [2-5], and *in vivo* and *in vitro* applications [6-8].

[1] Y. Morita, T. Takimoto, H. Yamanaka, K. Kumekawa, S. Morino, S. Aonuma, T. Kimura, and N. Komatsu,* *Small*, **4**, 2154-2157 (2008).
[2] L. Zhao, T. Takimoto, M. Ito, N. Kitagawa, T. Kimura, and N. Komatsu,* *Angew. Chem. Int. Ed.*, **50**, 1388-1392 (2011).
[3] L. Zhao, Y.-H. Xu, H. Qin, S. Abe, T. Akasaka, T. Chano, F. Watari, T. Kimura, N. Komatsu,* and X. Chen* *Adv. Funct. Mater.*, **24**, 5348-5357 (2014).
[4] N. Komatsu,* N. Kadota, T. Kimura, and E. Osawa, *Chem. Lett.* **36**, 398-399 (2007).
[5] Y. Zou, M. Nishikawa, N. Komatsu,* *Carbon Rep.*, **1**, 70-78 (2022).
[6] F. Yoshino, T. Amano, Y. Zou, J. Xu, F. Kimura, Y. Furusho, T. Chano, T. Murakami, L. Zhao,* N. Komatsu,* *Small*, **15**, 1901930 (2019).
[7] Y. Zou, S. Ito, M. Fujiwara, N. Komatsu,* *Adv. Funct. Mater.*, **32**, 2111077 (2022).
[8] Y. Zou, S. Ito, F. Yoshino, Y. Suzuki, L. Zhao, N. Komatsu,* *ACS Nano*, **14**, 7216-7226 (2020).

Jiaqi Zhu is a Professor at the School of Astronautics, Harbin Institute of Technology. He is a national high-level talent, a specialist for key special projects of the Ministry of Science and Technology and the Equipment Development Department, an expert in scientific and technological innovation of the State Administration of Science, Technology and Industry for National Defense, and Deputy Director of the National Engineering Research Center for Advanced Welding Technology.

His main research focuses on crystals and thin films. He currently serves as Vice Chairman of the Surface Engineering Branch of China Mechanical Engineering Society, Vice Chairman of the Extreme Materials and Devices Branch of Chinese Materials Research Society, and Vice President of China Instrument Materials Society. He acts as Associate Editor of Functional Diamond and Surface Science and Technology, and editorial board member of journals including Surface Technology, Journal of Synthetic Crystals, China Surface Engineering, Cryogenics & Vacuum, Functional Materials and Materials Science and Technology.

He has been awarded the China Youth Science and Technology Award, Heilongjiang May 4th Youth Medal and other honors. He has won two Second Prizes of National Technological Invention Award, one National Golden Patent Award and two First Prizes of Heilongjiang Provincial Technological Invention Award.

As the principal investigator, he has undertaken 6 National Natural Science Foundation projects including 1 key project, 2 national key R&D programs and other scientific research projects. His research achievements have been applied in multiple national key equipment models and realized industrialization.

He has obtained 167 authorized invention patents, among which 30 have been transferred and industrialized. He has published more than 200 academic papers in top international journals such as Science and Advanced Materials, authored 2 academic monographs and translated 1 academic book.

Topic: High-quality Diamond Growth & Semiconductor Applications

Name/Title: Prof. Jiaqi Zhu

Institute: School of Astronautics, Harbin Institute of Technology

Abstract:

Diamond serves as the core material of wide-bandgap carbon-based semiconductors and represents a strategically vital development trend for the next-generation semiconductor industry. Single-crystal diamond features high carrier mobility, ultra-high breakdown electric field and superior thermal conductivity, along with excellent chemical stability and outstanding radiation resistance, thus being hailed as the ultimate semiconductor material in the industry.

At present, synthetic diamonds have achieved large-scale mass application in tool fields such as cutting tools and diamond wires. Nevertheless, their popularization and application in high-value-added semiconductor fields are still restricted by insufficient material quality and core technical bottlenecks. The mainstream diamond synthesis methods are divided into high-pressure high-temperature (HPHT) method and microwave plasma chemical vapor deposition (MPCVD) method. Among them, MPCVD technology is capable of fabricating large-size diamond materials with low impurity content, and has become the preferred technical route for preparing diamond semiconductor wafers.

Our research team has long been committed to systematic research on high-quality MPCVD diamond materials, special synthesis equipment and semiconductor device applications. We have independently developed high-power MPCVD diamond growth equipment, broken through core crystal growth processes, and successfully developed various diamond semiconductor functional devices. The relevant research achievements possess broad industrialization prospects and great practical engineering application value.

Prof. Jinlong Liu is a full professor at the Institute for Advanced Materials and Technology, University of Science and Technology Beijing, China. He graduated from the Harbin Engineering University with a bachelor degree in materials science and technology in 2007, a master degree in materials science in 2009 from Harbin Institute of Technology and a doctor degree in materials science and technology from University of Science and Technology Beijing. He has mainly engaged in the research of functional diamond materials and their properties. More than 150 papers have been published in the fields of diamond performance regulation and device development. Over 20 projects have been led, including key projects of youth scientist projects of the National Key Research and Development Program, and so on. He serves as a member of the National Technical Committee for Standardization of Artificial Crystals, a director of the Heat Treatment Branch of the Chinese Mechanical Society, and an editorial board member or young editorial board member of journals such as the Journal of Artificial Crystals and Vacuum Electronics Technology. He has won five awards including the First Prize for Technological Invention of the Ministry of Education and the First Prize for Scientific and Technological Progress of the Chinese Materials Research Society.

Prof. Chengming Li is Professor of Institute for Advanced Materials and Technology (IAMT) at University of Science and Technology Beijing (USTB), Director of Carbon-Based Materials and Functional Films Laboratory at USTB. He obtained his B.E., M.E. and Ph.D. degrees in Materials Science and Engineering from USTB and finished post-doctor at Institute of Mechanics, Chinese Academy of Sciences (CAS). His research interests focus on CVD diamond film, single crystal and related functional applications. Chengming Li has engaged in diamond material research for more than 30 years as the director of Laboratory, developed the DC arc-jet plasma technology for large-size, crack-free, super-thick diamond plate deposition as well as microwave plasma technical equipment. His group firstly reported the electronic study of polycrystal & single crystal diamond in China. And, their researches of the thermal application of diamond film are at the advanced level all around the world, which also promoted the industrial application of CVD free-standing diamond films. He has directed or was involved in more than 60 main projects, including the National Science and Technology Major Project (sub-project), National Key R&D Program of China, International Intergovernmental Cooperation Project (EU Horizon 2020), National "863" project and National Natural Science Foundation of China, etc. To date, he has authored over 300 peer-reviewed carbon related publications and 80 authorized patents. He has been recipient of various awards and recognitions that include: Technical Invention of Ministry of Education of the People's Republic of China and Provincial Awards on Technology Advancement, etc.

Topic: Pulsed-Modulated Plasma Preparation of High-Strength and High-Hardness Diamond Films

Name/Title: Prof. Jinlong Liu, Prof. Chengming Li

Institute: Institute for Advanced Materials and Technology, University of Science and Technology Beijing

Abstract:

Diamond, as the hardest material in nature, holds irreplaceable value in applications such as cutting tools, drill bits, and grinding instruments. Enhancing diamond's ultimate hardness remains a major research focus. High-pressure high-temperature (HPHT) methods based on thermodynamic equilibrium can further increase its hardness, but are limited by extremely harsh conditions and relatively low toughness. To address this, we have enhanced both hardness and toughness of diamond through controlled non-equilibrium plasma in chemical vapor deposition (CVD). First, by growing periodic nitrogen-doped diamond films on single-crystal diamond surfaces, we achieved a fracture toughness of 18.2 MPa $m^{1/2}$ for CVD films with a single-layer thickness of 96 nm in the doped region—approximately 2.1 times higher than that of HPHT seed crystals. Second, we investigated the mechanical properties of ultra-hard polycrystalline diamond films under different nitrogen-doping cycles. Results show that film hardness initially increases and then decreases with reduced doping time, reaching a maximum of 208.3 GPa at a doping duration of 0.1 minutes—twice the hardness of conventional diamond. Microstructural analysis reveals abundant stacking faults within the diamond films, with a maximum fault density reaching 4.3×10^{12} cm^{-2}. Both extrusion-type and insertion-type stacking faults coexist, always occurring in two opposing directions and interweaving to form a high-density Lomer-Cottrell lock structure. This structure effectively impedes dislocation motion during deformation, thereby significantly enhancing hardness.

Dr. Meiyong Liao is a Chief Researcher at National Institute for Materials Science (NIMS), Japan and a joint Professor of University of Tsukuba, Japan. He received Ph.D. degree from the Institute of Semiconductors, Chinese Academy of Sciences, in 2002 (jointly with COSFAF, City University of Hong Kong). From 2002 to 2004, he was a Visiting Associate Professor at Kyoto University. He joined NIMS in 2004 and obtained a tenured research position in 2008. He was a visiting scientist at the French National Centre for Scientific Research (CNRS). His research focuses on wide-bandgap semiconductor materials (mainly diamond), physics, electronic and optoelectronics devices, and MEMS. Dr. Liao has published over 230 peer-reviewed papers with a citation over 18,000 times and an h-index of 68. Dr. Liao is the Co-Editor-in-Chief of Functional Diamond (Taylor & Francis) and the editorial boards of several international journals.

Topic: Diamond MEMS beyond Mechanics

Name/Title: Prof. Meiyong Liao

Institute: National Institute for Materials Science

Abstract:

Microelectromechanical systems (MEMS) based on diamond offer unparalleled advantages over conventional semiconductors, owing to their intrinsic properties, including exceptional mechanical strength, outstanding chemical and thermal stability, and an ultra-wide bandgap. Although polycrystalline diamond can be produced in large wafer sizes, MEMS devices based on it suffer from significant energy dissipation at grain boundaries and internal stress, which limit device performance, reproducibility, and reliability.

In this talk, we present a smart-cut method for the reproducible and controllable fabrication of single-crystal diamond (SCD) MEMS/NEMS structures, enabling on-chip integration for sensing applications. Beyond their extraordinary mechanical properties, we demonstrate the superior performance of diamond MEMS from the perspectives of deep defects and intrinsic thermomechanical noise, highlighting the advantages of diamond over other semiconductor materials. We have achieved single-crystal diamond MEMS cantilevers with quality factors exceeding one million at room temperature, along with temperature sensitivities at the nanokelvin level. Furthermore, we report the successful fabrication of high-reliability, on-chip diamond MEMS magnetic sensors, as well as nanoelectromechanical switches exhibiting nearly zero energy dissipation. Finally, fundamental mechanisms of energy dissipation in diamond MEMS are discussed, with comparisons to other material systems.

Hong-Xing Wang is a professor of Institute of Wide Bandgap Semiconductors, School of Electronic and Information Engineering at Xi'an Jiaotong University. He received his Ph.D from The University of Tokushima, Japan(2001). He joined Nitride Semiconductor Co. Ltd., Tokushima, Japan. As the senior researcher, he was engaged in research and development of GaN LED growth. 2003-2008, he was the executive director of Dialight Japan Co. Ltd. , Osaka, Japan. 2008-2013, he was the R&D manager in Seki Technotron Corp., Tokyo, Japan. In 2013, he moved from Japan to China and joined Xi'an Jiaotong University. His research interests focus on developing wide bandgap semiconductor materials and devices, (1) Development of MOCVD and MPCVD, (2) III-Nitride LEDs and power devices, (3) Single crystal diamond and devices, (4) Quantum sensing devices based on NV centers in diamond. He has more than 160 papers and 120 patents.

Topic: Progress of Diamond Material and Its Application

Name/Title: Prof. Hong-Xing Wang

Institute: School of Electronic Science and Engineering, Xi'an Jiaotong University

Abstract:

Diamond film collects all the outstanding properties such as a wide band gap (5.5 eV), low dielectric constant (5.5), high breakdown electric field (10 MV/cm), high carrier mobility (4500 $cm^2 \cdot V^{-1} \cdot s^{-1}$ (electron)) and high thermal conductivity (22 W/cm/K) together, making diamond a promising semiconductor material for high power, high frequency electronic applications or for sensing applications, which are able to operate in harsh environment.

In this talk, we report the progress of diamond semiconductor, including fabrication of large size single crystal diamond substrateby microwave plasma chemical vapor deposition system. We also present the new results about development of rf-FET, Schottky diode, power devices and diamond film for other semiconductor devices' heat spreader etc. The details will be presented in the conference.

Prof. Xiaojun Hu is professor in Zhejiang University of Technology, Hangzhou, China. She got her doctorate in Shanghai Jiaotong University in 2004. After that, she worked at Zhejiang University of Technology till now and became professor in 2011. Her research interest focuses on diamond, a kind of wide band semiconductor materials, including preparation, n-type doping, electrical and photoluminescent properties of diamond from experimental and computational view. She led 14 projects, published more than 120 papers on journals of Nat. Commun., PNAS, Adv. Sci., APL, and etc. She authorized 47 Chinese patents and 1 America patent as the first inventor. She hosted 5 international symposia as the conference chair, initiates and hosts 1 cross-strait symposium on diamond thin films and their functional devices. As the executive chairman or co-chair of the forum, she hosted three time of Chinese Superhard Materials Forum. She has given more than 30 invited presentations and served as session chair in the conferences as MRS, NDNC, IUMRS, and etc. She is editor-in-chief assistant of journal Functional diamond. She is a member of the editorial board of Superhard Materials and Engineering, and Diamond and Abrasive Mold Engineering, a member of the six expert committees of the Superhard Materials Branch of the China Machine Tool and Tool Builders' Association, and a member of the professional committee of Superhard Materials and Products of the China Society for Materials Research.

Topic: Ordinary-Pressure Phase Transformation from Graphite to Diamond

Name/Title: Prof. Xiaojun Hu

Institute: College of Materials Science and Engineering, Zhejiang University of Technology

Abstract:

The main preparation methods of diamond, such as high pressure and high temperature (HPHT) method and chemical vapor deposition (CVD) technique, require stringent conditions and high costs to grow diamond. It is necessary to develop a way to prepare diamond with more moderate conditions and lower cost. We discovered that mono-dispersed Ta atoms let sp^2 carbon transit to sp^3 carbon, which overturned the traditional concept that experimentally graphite just can transit to diamond under high temperature and high pressure. This mechanism further explained the diamond formation in CVD, in which graphite firstly grew and then transited to diamond via the help of monodispersed Ta atoms in hydrogen and oxygen complex atmosphere. Furthermore, Ta atoms were deposited onto graphite piece and diamond were formed after annealing under ordinary pressure, whose phase transition process was further discovered as that graphite first transforms into amorphous carbon, then to i-Carbon and n-Diamond, and finally to diamond. And vertical nanodiamond dominated sheets possessing both high capacitance and high n-type Hall mobility was prepared by using oxygen plasma treatment. These research developed a new way to prepare diamond based on graphite transition at ordinary pressure, which has significant importance for the diamond application.

Chia-Liang Cheng received his Ph. D. degree from the Physics Department of the University of Oregon, USA in 1993. After obtaining his Ph. D. degree, he was a post-doc with Prof Y.T. Lee (Nobel Laureate in Chemistry, 1986) at the Chemistry Department of the University of California, Berkeley and also Institute of Atomic and Molecular Sciences from 1994-1997. He was an assistant Professor in Dept of Physics, Normal University (1997-1998); then he moved to Dong Hwa University in 1998. He has served as Director, Department of General Education, and Director of Arts Center (2002-2005); Chairman of the Physics Department (2005-2008), Dean of Committee for General education (2009-2016), and Vice President of the University (2012-2016).

He is the Committee Member and Vice Chairman of C6 IUPAP (International Union of Physics and Applied Physics, 2021-2025, 2025- present). He was the Convener of Physics Review Panel (2021-2023). He has served in various Domestic and International Program Committees, such as Hasselt Diamond Workshop-SBDD (2017-); the International Conference on Diamond and Carbon Materials (2009-); International Steering Committee of International Conference on Raman Spectroscopy (2012-2018; 2018-); Advisory board member of *Journal of Raman Spectroscopy* (2017-); Editorial member, *International Journal of Nanoelectronics and Materials* (IJNeaM, May 2017-April 2019).

Topic: The Biomedical Applications of Nanodiamond

Name/Title: Prof. Chia-Liang Cheng

Institute: Department of Physics, Dong Hwa University

Abstract:

Nanodiamond (ND) has been showing great potential in bio/medical applications for bio imaging and drug delivery owing to its superb spectroscopic properties. The fluorescence properties of ND are determined by defects and admixtures in the crystal lattice or on the surfaces. This provides a stable and non-photobleaching fluorescence for imaging. ND's surface can be functionalized to form complexes with bio-molecules of interest. This renders ND the possibilities of drug conjugation and delivery. Combining these advantages, image-guided drug delivery systems for preclinical applications can be realized. In this talk I will share various examples that has been realized in the cellular models.

However conventional 2D cell culture model does not represent 3D structural of tissues and tumors, the 2D cellular models offer poor access to the efficiency of drug delivery. To address this, we developed a 3D multicellular tumor spheroid (MCTS) of Human alveolar basal epithelial cell (A549) cellular model to demonstrate the possibility of using ND for drug delivery and to evaluate the efficacy of the drug conjugate of ND-Drug in cancer therapy. When drug molecules are conjugated onto ND, the composed ND-X complexes are demonstrated in a 3D cellular model (MCTS), consisted of large collection of cells in a three-dimensional format extend about 0.7 mm in diameter; resemble the configuration of a tumor, ideal for evaluating the cytotoxicity and cytotoxicity mechanism of ND-drug complex and their efficacy. The drug molecules can be released in a pH dependent manner and enhanced drug efficacy can be achieved. Although this work presents only few examples, they demonstrate wide perspectives of development of NP with new synergic properties and of their use.

Prof. Haitao Ye is a full professor at the College of Future Information Technology, Fudan University, China. His research interests include gemstone valuation, CVD and PVD thin-film growth, electronic devices and sensors, wide-bandgap materials, thermoelectric materials, and antibacterial/antimicrobial materials. He holds a PhD from University College London and a Diamond Diploma (DGA) from the Gemmological Association of Great Britain. He has collaborated with many world-leading industrial partners on application-driven projects, including NTT, CEA, Rolls-Royce, Cambridge Semiconductors, Procter & Gamble, Teer Coatings Ltd, and Miba Coating Group. He is a Fellow of the Institute of Physics (FInstP), the Institute of Materials, Minerals and Mining (FIMMM), and the Higher Education Academy (FHEA), as well as a Chartered Engineer (CEng) in the UK. He has served as principal investigator for more than 20 international and national research projects and has published over 150 journal and conference papers. He also plays a major editorial leadership role in the field, serving as co-Editor-in-Chief of Functional Diamond (Taylor & Francis) and on the editorial boards of several other journals.

Topic: Corrosion Behaviour of Boron-doped Diamond Coatings

Name/Title: Prof. Haitao Ye

Institute: Fudan University

Abstract:

Silicon-based materials are widely used in photovoltaic and photoelectrochemical devices owing to their outstanding optoelectronic properties and established fabrication technologies. However, silicon is highly susceptible to passivation and corrosion in aqueous electrolytes, leading to rapid degradation of device performance. Boron-doped diamond (BDD) films have emerged as promising protective coatings because of their exceptional chemical inertness, tunable electrical conductivity, and high charge-carrier mobility.

In this work, BDD films with different boron concentrations were deposited on silicon substrates using hot-filament chemical vapor deposition (HFCVD). The relationship between boron concentration, film microstructure, and corrosion protection performance was systematically investigated. Structural characteristics were analyzed by scanning electron microscopy (SEM) and Raman spectroscopy, while the electrical properties were evaluated by Hall measurements. Electrochemical impedance spectroscopy (EIS) and potentiodynamic polarization tests were performed in a 3.5 wt% NaCl solution to assess the corrosion protection capability of the coatings.

The results show that the corrosion resistance of the BDD coatings strongly depends on the boron doping level. Among the investigated samples, the film with lower doping concentration exhibits the best protective performance, which is attributed to its relatively refined grain size and good crystalline quality. Compared with the undoped diamond film, the corrosion protection efficiency of the BDD coating with lower doping concentration improves by approximately 64%. These findings provide valuable guidance for optimizing boron doping concentration in BDD coatings for corrosion protection applications in harsh electrochemical environments.

Quan Li is Professor at The Chinese University of Hong Kong, China. She obtained her B.S. in Chemistry from Beijing University in 1997, and her PhD in Materials Science and Engineering from Northwestern University in 2001. She joined CUHK in 2002 as an Assistant Professor, and was promoted to Associate Professor and Professor in 2007, and 2011, respectively.

Her research interests include functional materials and structures for energy and biomedical applications, and quantum sensing. Her work of quantum sensing is devoted to diamond based sensor development and applications in both energy storage and biomedicine.

Topic: In Operando Nanothermometry in Electrocatalytic Devices by Nanodiamond Sensors

Name/Title: Prof. Quan Li

Institute: Department of Physics, The Chinese University of Hong Kong

Abstract:

The complex material architecture within the device, coupled with local variations in electrochemical activity, leads to a time-dependent and spatially varying temperature at the nanoscale. Measuring the spatially resolved temperature evolution in the device is challenging due to the lack of non-invasive and accurate nano-thermometry methods. In this presentation, I will discuss our recent progress in developing nanodiamond based thermometry to monitor the spatially resolved evolution in electrolyzers. We show that the local temperature within the working device, especially at the reaction interface, is considerably higher than the spatially averaged temperature measured from outside of the device using conventional methods. Spatial temperature variation has been found in conjunction with the respective electrochemical processes, disclosing the site sensitive chemical reactivity and its dynamics. This work is carried out in collaboration with Renbao Liu, Zan Li, Hui Wang, Yao Gao, and Ying Wang. The authors acknowledge funding support from RGC CRF C4004-23G.

Mingguang Yao, Tang Aoqing Distinguished Professor at Jilin University, has been consistently engaged in research on novel structures and properties of carbon under high pressure. He has achieved a series of advances in the study of high-pressure structural phase transitions of carbon materials and novel superhard carbon materials. As first or corresponding author, his work has been published in leading SCI-indexed journals including *Nature*, *Nature Materials*, *Nature Communications*, *Advanced Materials*, *Physical Review Letters, Journal of the American Chemical Society*, and *Advanced Functional Materials, etc*. His research results have been featured in dedicated highlights by journals such as *Nature* and *JACS* and incorporated into monographs published by Springer Nature. Notably, his work on near-full sp^3 amorphous carbon was highlighted by *Nature* as a **"breakthrough in materials science".** Prof. Yao has received numerous awards and funding, including the National Science Fund for Distinguished Young Scholars, the National Science Fund for Excellent Young Scholars, the Fok Ying-Tong Education Foundation Grant for Young Teachers, the Jilin Provincial Outstanding Contribution Talent Award, the First Prize of Jilin Provincial Natural Science Award, as well as the First Prize of Science and Technology Award from the Chinese Materials Research Society (C-MRS). He currently serves as an Editorial Group Member of National Science Review and Editor for *Materials Science and Engineering: B*.

Topic: Paracrystalline Graphite from High Pressure

Name/Title: Prof. Mingguang Yao

Institute: State Key Laboratory of High Pressure and Superhard Materials, College of Physics, Jilin University

Abstract:

The paracrystalline state lies between long-range ordered crystals and fully disordered noncrystalline systems, offering a unique perspective on how atomic disorder governs material properties. Although proposed by Hosemann over 70 years ago, its synthesis and structural verification have remained extremely challenging. Key unresolved questions include how to synthesize bulk paracrystalline materials, what is the structural nature of medium-range order (MRO), and how MRO dictates macroscopic properties. Addressing these issues is essential for on-demand design of material properties, yet requires precise control over paracrystalline synthesis.

In this talk, I will present the first bulk paracrystalline graphite (PG) synthesized from C_{60} under high pressure. Its unique 3D interwoven architecture — ~3 nm graphitic nanoclusters with a ~70° interlamellar angle — enables a rare synergy of high strength, high plasticity, and semimetallic conductivity. This work establishes paracrystalline order as a new design paradigm for extreme-environment materials.

Prof. Jianbo Liang is a researcher specializing in semiconductor heterogeneous integration, room-temperature wafer bonding, and advanced thermal management technologies for high-power electronic devices. His research focuses on the direct bonding and integration of wide-bandgap semiconductor materials, including diamond, GaN, SiC, and Ga_2O_3, for next-generation power electronics and advanced packaging applications.

He received his Master's degree and Ph.D. degree in Future Materials Engineering from Nagoya Institute of Technology, Japan, in 2009 and 2012, respectively. After completing his doctoral studies, he joined Osaka City University (currently Osaka Metropolitan University) later served as Lecturer and Associate Professor. In 2017, he was also a visiting researcher at the University of Bristol, United Kingdom.

Prof. Liang has developed several room-temperature direct bonding technologies for semiconductor heterogeneous integration, including GaN/diamond, diamond/Si, diamond/SiC, and SiC/Ga_2O_3 structures. His work demonstrated low thermal boundary resistance interfaces with excellent thermal stability, providing effective thermal management solutions for high-power devices.

He has published more than 150 papers in international journals, including Advanced Materials, Nature Communications, and Small, and has participated in multiple major projects funded by JSPS, NEDO, and JST.

Currently, Prof. Liang serves as the Director of the Heterogeneous Integration Advanced Technology R&D Center at the National Innovation Center for Third-Generation Semiconductor Technology (Suzhou), China, and Technical Director of Suzhou Jinghe Semiconductor Technology Co., Ltd.

Topic: Room-Temperature Direct Bonding of GaN and Diamond Toward Advanced Thermal Management of High-Power Electronics

Name/Title: Prof. Jianbo Liang

Institute: National Innovation Center for Third-Generation Semiconductor Technology (Suzhou)
Jiangsu Institute of Advanced Semiconductors
Suzhou Jinghe Semiconductor Technology Co., Ltd.

Abstract:

Diamond has attracted significant attention as an ideal thermal management material for next-generation high-power electronics owing to its ultrahigh thermal conductivity. However, the heterogeneous integration of diamond with GaN devices remains challenging because conventional high-temperature bonding processes often induce large thermal stress, interface degradation, and reliability issues caused by the significant mismatch in thermal expansion coefficients between the two materials. In this work, we demonstrate a room-temperature direct bonding technology for GaN and diamond based on surface activated bonding (SAB), enabling the fabrication of GaN-on-diamond structures with low thermal boundary resistance and high thermal stability.

The bonding process was performed under ultrahigh vacuum conditions without any intermediate adhesive layer or high-temperature annealing. High-resolution transmission electron microscopy revealed the formation of an atomically bonded interface with a nanoscale amorphous interlayer. The bonded interfaces exhibited excellent mechanical strength and thermal robustness even after high-temperature annealing. Thermal characterization demonstrated a significant reduction in interfacial thermal resistance, leading to greatly enhanced heat dissipation capability compared with conventional substrates.

Furthermore, GaN high-electron-mobility transistors (HEMTs) fabricated on diamond substrates exhibited substantially reduced self-heating effects and improved device thermal performance. The proposed room-temperature bonding approach provides a promising pathway toward advanced thermal management technologies for high-power and high-frequency electronic devices, while maintaining compatibility with future heterogeneous integration and advanced packaging applications.

Nan Huang is Professor at Institute of Metal Research, Chinese Academy of Sciences, China. She obtained her B.S. and Master degree in Materias science and Engineering from Jilin University in 2005 and 2007, and her PhD degree in Materials Science and Engineering from Institute of Metal Research, Chinese Academy of Sciences in 2011. After completing doctoral studies, she joined Institute of Metal Research, Chinese Academy of Sciences as Assistant Professor in 2011. In 2012, 2014 and 2015, and she was also a visiting researcher at the University of Siegen, Germany. She was promoted to Associate Professor and Professor in 2014 and 2023, respectively.

She leads the Diamond Materials research group at the institute of Metal Research, Chinese Academy of Sciences since 2025. The group work interests include the microwave plasma CVD, hot-filament CVD, novel diamond growth, doping, microstructure characterisation, designing in-situ spectroscopy-electrochemistry devices and applying diamond materials in semi-conductor, energy, biomedicine, sensing, resource utilization and extreme-environment et. al. To date, She has published more than 90 academic papers in Advanced Energy Materials, Advanced Functional Materials, et al., has obtained 32 authorized patents among which 1 has been transferred industry and published 2 English version book chapters.

Topic: Growth and Applications of Novel Diamond Materials

Name/Title: Prof. Nan Huang

Institute: Shenyang National Laboratory for Materials Science, Institute of Metal Research, Chinese Academy of Sciences

Abstract:

Diamond, composed of carbon in a sp^3 configuration, is an ultra-wide bandgap semiconductor material that exhibits outstanding mechanical, physical, and chemical properties, including high hardness, high elastic modulus, high thermal conductivity, and chemical stability. The CVD is a key technique to grow the diamond materials.

In this talk, I will present the different novel diamond materials including diamond-graphite structure, diamond-expand graphite structure, and boron-doped diamond with nanostructures by CVD technique, their unique microstructure and applications in our group. Additionally, it will present the team's recent advancements in the CVD technological development and engineering applications of large-scale boron-doped diamond.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