JAIST
JAPAN ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY 1990

14th (Wed.), December 2022

2022 JAIST International Symposium of Nanomaterials and Devices Research Area

Quantum Devices and Metrologies

In April 2022, Japan Advanced Institute of Science and Technology (JAIST) renewed the research areas of the graduate school of Advanced Science and Technology into 10 areas. **The "Nanomaterials and Devices Research Area"** has launched to work on the synthesis/growth of " emerging nanomaterials" and their characterization using "cutting-edge methods" as well as their application in "devices and sensing".

We hold a symposium sponsored by JAIST inviting two keynote lecturers and one invited speaker focusing on "**Quantum Devices and Metrologies**": receiving a lot of attention for future quantum technologies. This symposium will provide a platform for scientific exchange in all research areas and our students both breadth and depth in their educational and research experiences at JAIST.

The symposium will be held in a hybrid way, including onsite **(KS Lecture Hall (2nd floor, KS Lecture Building, JAIST)** and on **WEBEX online** platform. Participants are required to be registered before 5th December 2022 so that the details, such as WEBEX link, can be sent. Please click the register link below.

Registration link: https://forms.gle/tyk9v775xJdFLFzh8

Chair: Toshu An, toshuan@jaist.ac.jp
Associate Professor, Nanomaterials and Devices Research Area, Advanced Science and Technology, Japan Advanced Institute of Science and Technology

Keynote lecturers:

Dr. Eisuke Abe (RIKEN Center for Quantum Computing)

https://quantum.riken.jp/english.html

Prof. Carlos A. Meriles (CUNY-City College of New York)

https://cmeriles.ccny.cuny.edu/

Invited talk:

Prof. Takeshi Fukuma (Nano Life Science Institute (WPI-Nano LSI), Kanazawa Univ.)

https://nanolsi.kanazawa-u.ac.jp/en/post-5232/

Program: KS Lecture Hall

9:30	Opening	Masahiko Tomitori（JAIST）
9:40-10:40	(Keynote lecture) Superconducting route to quantum computing Eisuke Abe (RIKEN Center for Quantum Computing)	
10:40-10:50	Break	
10:50-11:40	Atomic scale operand metrology via TEM Yoshifumi Oshima (JAIST)	
11:40-12:05	Introduction of Advanced Research Infrastructure for Materials and Nanotechnology (ARIM) in JAIST Yukiko Yamada-Takamura (JAIST)	
12:05-13:35	Lunch	
13:35-14:35	(Keynote lecture) Controlling the charge state of color centers at the nanoscale: Challenges and opportunities. Carlos A. Meriles (CUNY-City College of New York)	
14:35-14:45	Break	
14:45-15:35	Development of scanning diamond NV center probes for quantum sensing and imaging Toshu An (JAIST)	
15:35-16:25	(Invited) Visualizing inside of 3D self-organizing systems by 3D atomic force microscopy Takeshi Fukuma (Nano Life Science Institute (WPI-Nano LSI), Kanazawa Univ.)	

MS Lecture Room 1, 2

16:30 -18:30 Poster session

Info.

60 min. Keynote: 50 min. talk and 10 min. question and answer

50 min. Invited talk and talk by JAIST faculty: 40 min. talk and 10 min. question and answer

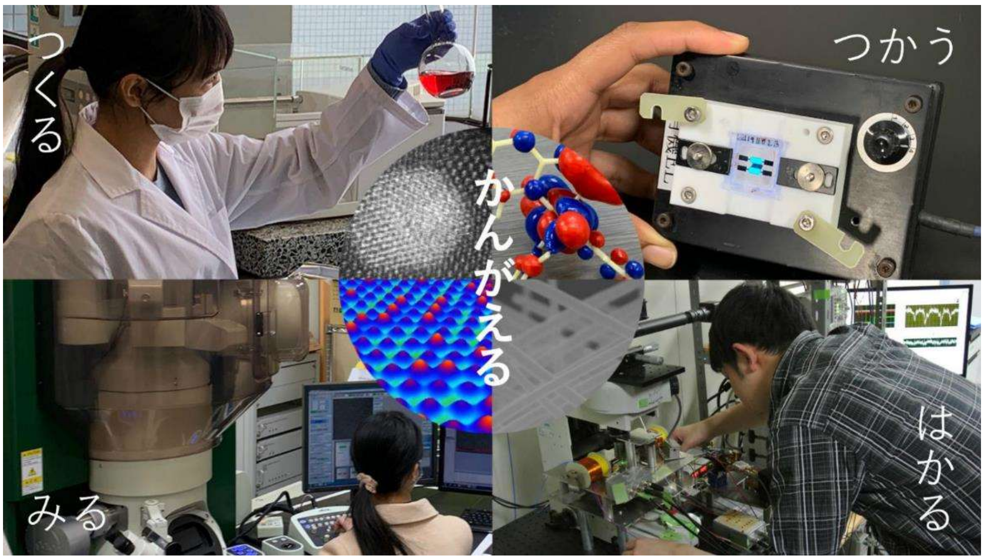
25 min. talk by JAIST faculty: 20 min. talk and 5 min. question and answer

talk remaining time 5 min. 1 ring

talk end time 2 ring

Any format of poster (< A0 size) can be put on the board.

Student poster award will be selected.



Abstracts

Key note

Title: Superconducting route to quantum computing

Eisuke Abe (RIKEN Center for Quantum Computing)

Large-scale quantum computers will solve certain problems that are intractable by classical computers available today. Coherent control of a Cooper-pair box was first demonstrated more than twenty years ago in Japan, triggering the worldwide research on superconducting qubits. Consecutive efforts to improve design, materials, qubit coherence, and control fidelity since then have led to a recent dramatic increase in the number of available qubits. Still, there are many things to be done in order to scale up the system and move from noisy intermediate-scale quantum (NISQ) devices to error-correctable, and ultimately fault-tolerant, quantum computers. In this talk, I will review recent advances in the field and discuss the superconducting qubit hardware developed at RIKEN.

Title: Controlling the charge state of color centers at the nanoscale: Challenges and opportunities.

Carlos A. Meriles (CUNY-City College of New York)

Charge control of color centers in semiconductors promises opportunities for novel forms of sensing and quantum information processing. This presentation discusses recent experiments combining confocal fluorescence microscopy and magnetic resonance protocols to induce and probe charge transport between discrete sets of engineered nitrogen-vacancy (NV) centers in diamond, down to the level of individual defects. Our observations reveal giant capture cross-sections exceeding typical values by two or three orders of magnitude, a result we attribute to the high sample purity (and, correspondingly, the lack of screening effects). Building on a theoretical framework and numerical simulations, we will also discuss the impact of external electric fields, as well as the formation of Rydberg states bound to color centers but extended over macroscopic distances. Finally, we will present recent results demonstrating NV charge state control with sub-diffraction resolution, and briefly discuss potential applications to high-density optical data storage in three dimensions.

Invited

Title: Visualizing inside of 3D self-organizing systems by 3D atomic force microscopy

Takeshi Fukuma (Nano Life Science Institute (WPI-Nano LSI), Kanazawa Univ.)

Atomic force microscopy (AFM) has been a powerful tool for imaging atomic- or molecular-scale surface structures even in liquids. However, such high-resolution imaging was traditionally limited to atoms or molecules firmly fixed to a solid substrate. This situation is about to change owing to the development of 3D-AFM techniques. In 3D-AFM, a tip is three-dimensionally scanned in both lateral and vertical directions and the force exerted onto the tip apex is recorded to produce a 3D force map. The obtained force map represents the distribution of surrounding water or flexible molecular features. While 3D-AFM has been mostly used for imaging 3D hydration structures, we are now expanding its application areas to investigate various 3D self-organizing systems, including ionic liquids, swollen polymers, organelles and cells.