

# IAMNano 2023

*International Workshop on Advanced and In-situ Microscopies  
of Functional Nanomaterials and Devices*

## Program and Abstracts



June 28<sup>th</sup> – July 1<sup>st</sup>, 2023  
Venue: Kunibiki Messe, Matsue, Shimane, Japan

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# Technical Program

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## DAY1, June 28, 2023

0840

### Opening Ceremony

**S1** **Advanced TEM/STEM Imaging I | Chair: Yimei Zhu**

0900 S1-01 **Prospects and Opportunities for Electron Ptychography at Low Dose**

Angus Kirkland

0930 S1-02 **Three-dimensional Atomic Structure of Crystal Defects and Amorphous Materials**

Jianwei (John) Miao

1000

Coffee break

**S2** **In-situ TEM/STEM I | Chair: Robert Sinclair**

1015 S2-03 **Unveiling the Heterogeneity in Nanomaterials Transformations**

Haimei Zheng

1045 S2-04 **Multimodal, In-situ Characterization of Bimetallic Nanoparticles with Electrons and X-rays**

Eric A. Stach

1115 S2-05 **Site-specific In situ Electron Microscopy of Strain Engineering of Electronic and Optoelectronic Properties of Semiconductor Nanostructures**

Eva Olsson

1145 VP-01 **Machine Vision Enabled Solutions for TEM Data Collection and Management**

Protochips

1200

Group Photo

1215 Luncheon I **Introduction of new FIB-SEM system JIB-PS500i with easy TEM specimen transfer workflow**

JEOL

**S3** **Advanced Spectroscopy I | Chair: Quentin Ramasse**

1315 S3-06 **Emergent Phonon Phenomena at Interfaces Probed by Vibrational Electron Microscopy**

Xiaoqing Pan

1345 S3-07 **Revealing Topological Properties of Materials: The New Characterization Frontier in Electron Microscopy**

Juan Carlos Idrobo

1415 S3-08 **Applications of 4D-EELS**

Peng Gao

1445

Coffee break

**S4** **Phase Imaging I | Chair: Rafal Dunin-Borkowski**

1515 S4-09 **Using 4D-STEM to Characterize Nanoscale Materials in 2D and 3D**

Colin Ophus

1545	S4-10	<b>Magnetic-field-free Atomic Resolution Scanning Transmission Electron Microscopy</b> Naoya Shibata
1615	S4-11	<b>Nano-scale Crystal Structure Analysis Using Convergent-beam Electron Diffraction</b> Kenji Tsuda
1645	S4-12	<b>Electron Holography Study on the Charging State of Catalyst Nanoparticle</b> Yasukazu Murakami
1715	VP-02	<b>Optimizing Dose in STEM: More Information with Less Damage</b> JEOL

**1745 – 1915** Poster session | Odd numbers

**1950 –** Conference Reception @ Hotel Ichibata

## DAY2, June 29, 2023

<b>S5</b>		<b>Advanced TEM/STEM Imaging II   Chair: Angus Kirkland</b>
0830	S5-13	<b>Novel Image Contrast Mechanisms in 4D-STEM</b> Joanne Etheridge
0900	S5-14	<b>From 4D STEM to Crystal Structure via the Scattering Matrix</b> Scott D. Findlay
0930	S5-15	<b>Three-dimensional Imaging by STEM Depth Sectioning</b> Ryo Ishikawa
1000		Coffee break
<b>S6</b>		<b>Advanced characterization I   Chair: Wolfgang Jaeger</b>
1015	S6-16	<b>Structural Degree of Freedom for Energy Storage Materials</b> Lin Gu
1045	S6-17	<b>Probing Nanoscale Light-matter Interactions Using Fast Electrons</b> Andrew B. Yankovich
1115	S6-18	<b>STEM and EELS for Data-driven Material Research</b> Koji Kimoto
1145	VP-03	<b>Vacuum Transfer System for EM Application Combined with a Cryogenic Technique</b> Mel-Build
1200	Luncheon II	<b>An Introduction of Hitachi's TEM Analysis Solutions toward the Carbon Neutrality</b> Hitachi High-Tech

<b>S7</b>		<b>Advanced characterization II   Chair: Nobuo Tanaka</b>
1315	S7-19	<b>Cryogenic Electron Microscopy for Quantum Materials</b> Yimei Zhu
1345	S7-20	<b>Advanced S/TEM for Understanding Transport and Optical Properties of Semiconductor Nanowires and Interfaces</b> Wolfgang Jaeger
<b>1415 – 1615</b>		<b>Poster session   Even Numbers</b>
<b>1715 –</b>		<b>Conference Banquet @ Yuushien</b>

## DAY3, June 30, 2023

<b>S8</b>		<b>Advanced Spectroscopy II   Chair: Juan Carlos Idrobo</b>
0830	S8-21	<b>Electron Microscopy and Spectroscopy of Low-dimensional Hybrid Materials</b> Kazu Suenaga
0900	S8-22	<b>Single-atom Vibrational Spectroscopy with Chemical Bonding Sensitivity</b> Wu Zhou
0930	S8-23	<b>Studying the Electronic Structure of Hetero-interfaces for Spintronics Using Dark-field EELS at Atomic Resolution</b> Quentin Ramasse
1000	S8-24	<b>High-energy Electron Energy-loss Spectrometry System for Advanced Analytical Electron Microscopes</b> Masashi Watanabe
1030	VP-04	<b>Imaging and analysis of beam sensitive materials, state-of-the-art and promising prospects</b> Thermo Fisher Scientific
<b>1045 – 1200</b>		<b>Poster session   All posters</b>
<b>1200 – 1245</b>		<b>Lunch</b>

<b>S9</b>		<b>Advanced TEM/STEM Imaging III   Chair: Joanne Etheridge</b>
1245	S9-25	<b>The Role of Correlative CT and TEM Investigations in the Development of Battery Technology</b> Joachim Mayer
1315	S9-26	<b>Atomic Resolution Transmission Electron Microscopy with Information Science (ARTEMIS) for High-speed Dynamic Observation</b> Tsukasa Hirayama

1345	VP-05	<b>Atomic-Resolution Secondary Electron Imaging for Studying Surface Atom Configurations of Nanocatalysts</b> Hitachi High-Tech
1415		Coffee Break
	<b>S10</b>	<b>Advanced characterization III   Chair: Kazu Suenaga</b>
1445	S10-27	<b>Circumscribed Ferroelectricity by Phonon-decoupled Oxygen Tetrahedra in Brownmillerite Oxides</b> Si-Young Choi
1515	S10-28	<b>Atomic Mapping of Topological Domains in Ferroelectric Films</b> Xiuliang Ma
1545		Break
	<b>S11</b>	<b>In-situ TEM/STEM II   Chair: Eric Stach</b>
1600	S11-29	<b>In-situ TEM of Dynamics of Lattice Defects in Metals</b> Kazuto Arakawa
1630	S11-30	<b><i>In Situ</i> Scanning Transmission Electron Diffraction of Individual Electrically Biased Ag-In-Sb-Te Phase Change Memory Line Cells</b> Rafal E. Dunin-Borkowski
1700	S11-31	<b>Twisted Epitaxy of Gold Nanoparticles in Twisted MoS<sub>2</sub> Bilayers: Prospects for In Situ TEM Studies</b> Robert Sinclair
1730		<b>Closing Ceremony</b>
<b>1830</b>		<b>JEOL Banquet @ Excel Hotel Tokyu</b>

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## Poster Program

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### Group A: Advanced imaging with aberration-corrected TEM and STEM

- P-A01 **Arrangement of 3D Structural Units for Tilt Grain Boundaries**  
K. Inoue, J. Roh, K. Kawahara, M. Saito, M. Kotani, and Y. Ikuhara
- P-A02 **Observation of Grain Boundary Migration in Al<sub>2</sub>O<sub>3</sub> at Atomic Scale**  
B. Feng, J. Wei, N. Shibata, and Y. Ikuhara
- P-A03 **Atomic-resolution STEM Image Denoising by Total Variation Regularization**  
K. Kawahara, R. Ishikawa, S. Sasano, N. Shibata, and Y. Ikuhara
- P-A04 **Three-dimensional Structure Analysis of SrTiO<sub>3</sub> Σ5 Grain Boundary by STEM Depth Sectioning**  
T. Imata, R. Ishikawa, K. Kawahara, S. Sasano, Y. Ikuhara, and N. Shibata
- P-A05 **Grain Boundary Structural Transformation Induced by Co-segregation of Aliovalent Dopants**  
T. Futazuka, R. Ishikawa, N. Shibata, and Y. Ikuhara
- P-A06 **Low-dose Atomic-resolution Imaging of Beam-sensitive Materials Using Optimum Bright-field STEM Technique**  
K. Ooe, T. Seki, K. Yoshida, Y. Kohno, Y. Ikuhara, and N. Shibata
- P-A07 **Time-resolved TEM Observation of CeO<sub>2</sub> Surfaces with Electrostatic Sub-framing System**  
T. Sasaki, K. Noguchi, Y. Jimbo, Y. Ninota, T. Kaneko, K. Yagi, S. T. Park, R. S. Bloom, and B. W. Reed
- P-A08 **Theoretical Investigation on Sixth-order Geometrical Aberration Correctors**  
S. Morishita, and H. Sawada
- P-A09 **Investigation of Oxygen Defect Formation in SrCrO<sub>3-δ</sub> by Electron Beam Irradiation**  
G. Koinuma, S. Kobayashi, T. Kosuge, T. Yamamoto, and A. Kuwabara
- P-A10 **Optical Sectioning Microscopy by Scanning Transmission Electron Microscope (STEM) Equipped with Higher Order Aberration Corrector**  
H. Hashiguchi, Y. Jimbo, I. Ohnishi, R. Sagawa, and Y. Kondo
- P-A11 **Atomic Structure Analysis of Silicon Steel Grain Boundaries by STEM Observations and Theoretical Calculations**  
M. Arai, T. Futazuka, T. Seki, N. Morishige, R. Matsubara, Y. Ikuhara, and N. Shibata
- P-A12 **Direct Imaging of Local Anisotropic Atomic Vibrations**  
K. Tabata, T. Seki, Y. Ikuhara, and N. Shibata

## **Group B: Phase and field imaging, including holography, 4D-STEM, and DPC-STEM**

- P-B13      **Fast 4D STEM with ARINA Hybrid-pixel Detector**  
D. Stroppa, M. Meffert, C. Hoermann, P. Zambon, and L. Piazza
- P-B14      **Low-energy Electron Holography Imaging of Individual Proteins**  
H. Ochner, S. Szilagy, M. Edte, S. Abb, J. Gault, C. V. Robinson, S. Rauschenbach, L. Malavolti, and K. Kern
- P-B15      **Direct Observation of Cu in High-silica Chabazite Zeolite by Electron Ptychography**  
K. Mitsuishi, K. Nakazawa, R. Sagawa, M. Shimizu, H. Matsumoto, H. Shima, and T. Takewaki
- P-B16      **Precise Measurement of Magnetic Domain Wall Width and Evaluation of Local Magnetic Properties by DPC STEM**  
Y. O. Murakami, T. Seki, Y. Ikuhara, and N. Shibata
- P-B17      **Electric Field Observation in a p-n Junction by In-situ Biasing DPC STEM**  
Y. Kojima, S. Toyama, T. Seki, Y. Ikuhara, and N. Shibata
- P-B18      **Diffraction Contrast of Ferroelectric Domains in DPC STEM Images**  
M. Takamoto, T. Seki, Y. Ikuhara, and N. Shibata
- P-B19      **Development of STEM Imaging Parameter Analysis Method Using a Pixelated Detector and its Application to OBF STEM**  
M. Nogami, T. Seki, K. Ooe, Y. Ikuhara, and N. Shibata
- P-B20      **Direct Observation of Magnetic Domain Structure in a Ferromagnetic Quasicrystal by DPC STEM**  
T. Iwata, T. Seki, A. Ishikawa, R. Tamura, Y. Ikuhara, and N. Shibata
- P-B21      **Linear Imaging Theory of Differential Phase Contrast STEM**  
T. Seki, K. Khare, Y. O. Murakami, S. Toyama, G. Sanchez-Santolino, H. Sasaki, S. D. Findlay, T. C. Petersen, Y. Ikuhara, and N. Shibata

## **Group C: Advanced spectroscopy, including EELS and EDS**

- P-C22      **Analysis of Irreversible Passivation Layer at the Interface between Layered Cathode Active Materials and Solid Electrolyte in Sulfide-based All-solid-state Batteries**  
S. Kobayashi, T. Kato, and A. Kuwabara
- P-C23      **Atomic Structures and Ti Segregation Behaviors in Al<sub>2</sub>O<sub>3</sub> Grain Boundaries**  
C. Yang, B. Feng, N. Shibata, and Y. Ikuhara
- P-C24      **Investigating Anisotropic Behavior of Oxygen Vibration in SrTiO<sub>3</sub> and PbTiO<sub>3</sub> by Ti L<sub>2,3</sub>-edge EELS Spectrum**  
I. Lin, M. Haruta, T. Nemoto, and H. Kurata
- P-C25      **Development of Total Integrated Analysis Platform “FEMTUS™”**  
E. Okunishi, M. Nishikawa, K. Somehara, S. Hirata, Y. Tsuzuku, Y. Kazama, K. Tachibana, S. Hisada, A. Nakamura, and K. Miyatake
- P-C26      **C-K Edge Spectral Database and Spectral Prediction Using Graph Convolutional Network**  
K. Shibata, and T. Mizoguchi
- P-C27      **Machine Learning for EELS**  
T. Mizoguchi, P. Chen, I. Takahara, and K. Shibata



## Group D: In-situ and environmental TEM and STEM

- P-D28 **In-situ Lorentz Microscopy with Dynamic External Magnetic Field**  
Z. Akase, T. Sato, and H. Magara
- P-D29 **Fabrication of Graphene Liquid Cell for TEM Observation of Ice Nucleation in Water**  
Y. Yashima, T. Yamazaki, and Y. Kimura
- P-D30 **In-situ TEM Study of the Crack Propagation along Grain Boundaries in Al<sub>2</sub>O<sub>3</sub>**  
J. Yan, S. Kondo, B. Feng, N. Shibata, and Y. Ikuhara
- P-D31 **Direct Observations of Sessile Dislocation Core Structural Changes by *In Situ* STEM Mechanical Testing**  
M. Cao, E. Tochigi, T. Sato, N. Shibata, and Y. Ikuhara
- P-D32 **Gas-liquid Interfacial Phenomena in Graphene Liquid Cells**  
S. Hirokawa, H. Teshima, P. S. Fernandez, H. Ago, Q. Li, and K. Takahashi
- P-D33 **Direct Observation of Thermally Induced Martensitic Transformation in Yttria-stabilized Zirconia**  
H. Shibaguchi, S. Kondo, B. Feng, N. Shibata, and Y. Ikuhara
- P-D34 **In Situ TEM Observation of the Interaction between Screw Dislocations and Prismatic Dislocation Loops in Iron**  
T. Inoue, T. Mizutani, Y. Sugimoto, and K. Arakawa
- P-D35 **In-situ Observation of Oxygen Diffusion During Topotactic Phase Transformation of a Perovskite Oxide**  
Y. Xing, I. Kim, K. T. Kang, W. S. Choi, J. Lee, and S. H. Oh
- P-D36 **Drift Correcting *In-situ* Datasets in DigitalMicrograph v3.6**  
F. C. Castro, B. K. Miller, L. Spillane, and C. Czarnik
- P-D37 **Investigation of Atomic Behavior of Crack Tips in SrTiO<sub>3</sub> under Loading by In Situ STEM Observations**  
E. Tochigi, T. Sato, M. Cao, N. Shibata, and Y. Ikuhara
- P-D38 **In Situ Heating Observation of Crystallization in Ionic Conductor Na<sub>3</sub>PS<sub>4</sub>**  
H. Nakajima, H. Tsukasaki, A. Sakuda, A. Hayashi, and S. Mori
- P-D39 ***In-situ* TEM Observation Technique Using the FIB-TEM Compatible MEMS Specimen Heating Holder**  
T. Yaguchi, A. Wakui, K. Ito, H. Asakura, Y. Nagakubo, M. Li, and Z. Shan
- P-D40 **In Situ TEM Study on the Structural Stability of High-entropy Alloy Nanoparticles**  
H. Yoshida, N. Kamiuchi, N. Hashimoto, and K. Mori
- P-D41 **In-situ Gas Reaction Observation System Equipped with Mass-spectrometer**  
K. Fukunaga, I. Ohnishi, T. Fukudome, M. Hashimoto, M. Ubukata, K. Okuda, and Y. Guo
- P-D42 **Direct Observations of Dislocation-Grain Boundary Interactions via In situ TEM Nanoindentation**  
S. Kondo, E. Tochigi, N. Shibata, and Y. Ikuhara
- P-D43 **Time-resolved TEM for Elucidating Non-equilibrium Molecular Dynamics**  
T. Nakamuro, M. Sakakibara, K. Kamei, K. Harano, and E. Nakamura
- P-D44 **Direct Observation of Metastable Polymorph Formation by SMART-EM Imaging**  
M. Hanazawa, X. Li, T. Nakamuro, and E. Nakamura

- P-D45 **Catalytic Activities of Surfaces and Mechanical Stimulus for Crystal Growth Revealed by Millisecond TEM Imaging**  
M. Sakakibara, H. Nada, T. Nakamuro, and E. Nakamura
- P-D46 **Analysis of Shear Plane Formation Mechanism in Single Crystal  $\text{TiO}_{2-x}$  Memristor by Using *In-situ* TEM Observation**  
R. Takada, N. Taniguchi, T. Tohei, Y. Hayashi, and A. Sakai
- P-D47 **EELS Analysis of Ceria Nano-powders under Reducing Gas Atmospheres**  
T. Yamamoto, Y. Kawami, J. Matsuda, Y. Murakami, and S. Matsumura

## Group E: Advanced characterization of functional nanomaterials and devices

- P-E48 **In-situ Microscopy of Successive Ferroelectric-antiferroelectric Transition in Antiferroelectric Oxides**  
R. Jiang, X. Ma, and Y. Zhu
- P-E49 **Structural Defects in  $(\text{Ta}_{1-x}\text{Ti}_x)\text{Se}_2$  Revealed by Cross-sectional Transmission Electron Microscopy and Electron Diffraction**  
K. Sato, and T. Matsushita
- P-E50 **Atomic-Scale Observation of Isostructural Metal-Insulator Transition in Cation-Doped  $\text{VO}_2$  Thin Films**  
H. Sim, Y. Park, J. Son, and S. Choi
- P-E51 **Moiré Charge Localization in Twisted Freestanding Oxide Membranes**  
M. Kim, K. Lee, K. Song, K. Eom, C. Eom, and S. Choi
- P-E52 **Atomic-scale Understanding of the Electrochemically Favored Dopant on the Nickel-rich Layered Cathodes**  
S. Kim, Y. Yang, M. Kim, E. G. Lee, K. Go, G. Kim, M. Kim, S. Choi, and S. Choi
- P-E53 **Atomic Diffusion Driven Grain Growth Behavior of  $\text{MoS}_2$  Microstructure**  
C. Choi, M. Choi, C. Kim, and S. Choi
- P-E54 **Configurable Flexoelectric Effect in Atomic Gradient Thin Films**  
S. Hwang, S. Kim, D. Lee, and S. Choi
- P-E55 **Atomistic Origin of Grain Boundary Resistivity in  $(\text{Li}_{3x}\text{La}_{2/3-x})\text{TiO}_3$**   
S. Sasano, R. Ishikawa, H. Ohta, N. Shibata, and Y. Ikuhara
- P-E56 **Direct Imaging of Thermal Vibration Modes Using Frequency-selective Electron Microscopy**  
O. Cretu, H. Zhang, and K. Kimoto
- P-E57 **Revealing Distinctive Crystal Structure of Metatitanic Acid Nanoparticles by Data-driven Electron Microscopy Analysis**  
K. Aso, and Y. Oshima
- P-E58 **Composite Anode for Fluoride-ion Batteries Using the Formation of an Intermetallic Phase**  
K. Nakayama, H. Miki, T. Nakagawa, Y. Sugawara, S. Kobayashi, K. Noi, K. Sakurai, H. Iba, A. Kuwabara, and Y. Ikuhara
- P-E59 **Nano- and Atomic-scale Structural Changes in Heavily Delithiated  $\text{LiCoO}_2$**   
K. Nakayama, S. Kobayashi, R. Ishikawa, A. Kuwabara, and Y. Ikuhara
- P-E60 **Structural Evolution of Trapped Oxides in Cold-spray Cu Coatings**  
J. Tam, J. D. Giallonardo, J. Howe, and U. Erb
- P-E61 **Grain Boundary Relaxation in Bulk Electroformed Nanocrystalline Ni-Co Alloy - An *In Situ* TEM Annealing Study**  
J. H. Kong, J. Tam, J. L. McCrea, J. Y. Howe, and U. Erb
- P-E62 **1D Ordered Atomic Structure in MgO Grain Triple Junction**  
M. Saito, D. Yin, C. Chen, K. Inoue, and Y. Ikuhara
- P-E63 **Transient Phenomena of Plasmons on Gold Nanoparticle Investigated by Time-resolved TEM**  
M. Kuwahara, T. Ishida, H. Morishita, S. Kuwahara, and T. Agemura

- P-E64 **Structure Analysis of Twin Domain Boundaries Using Convergent-beam Electron Diffraction**  
D. Morikawa, Y. Noguchi, and K. Tsuda
- P-E65 **Interdiffusion in Bimetallic Au-Fe Nanowhiskers Controlled by Interface Mobility**  
E. Suadiye, Y. Qi, G. Richter, L. Klinger, and E. Rabkin
- P-E66 **Plastic Forming of Metals at the Nanoscale: Interdiffusion-induced Bending of Bimetallic Nanowhiskers**  
E. Suadiye, Y. Qi, G. Richter, M. Kalina, and E. Rabkin
- P-E67 **Simultaneous Measurement of Dynamic and Structural Heterogeneities in Glass via 5D-STEM**  
K. Nakazawa, S. Kohara, and K. Mitsuishi
- P-E68 **Visualising Sub-nanometre Spatial Distribution of Individual Molecular Dopants of Organic Semiconductors in Three Dimensions**  
G. Persson, E. Jarsvall, M. Roding, R. Kroon, Y. Zhang, S. Barlow, S. Marder, C. Muller, and E. Olsson
- P-E69 **In Situ Straining and Electrical Characterization of Semiconductor Nanowires and 2D-Materials**  
J. Holmer, L. Zeng, T. Kanne, P. Krogstrup, J. Nygard, L. d. Knoop, and E. Olsson
- P-E70 **Atomic-resolution STEM Observation of a PZT/SRO/Pt Epitaxial Thin Film**  
S. Hashimoto, T. Seki, Y. Ikuhara, and N. Shibata
- P-E71 **Modulation and Interface Structures of LLNBO Related Lithium Ion Battery Crystals**  
Y. H. Ikuhara, S. Kobayashi, A. Kuwabara, and Y. Ikuhara
- P-E72 **STEM-EDS Study of 3YSZ Polycrystals Fabricated by Ultrafast High-temperature Sintering**  
R. Murakami, B. Feng, K. Matsui, N. Shibata, and Y. Ikuhara
- P-E73 **SEM Combined with FIB Cross-sections Revealing the Impact of Steam Explosion Pre-treatment on the Norway Spruce Wood Microstructure**  
M. Brollo, F. Caputo, L. Olsson, and E. Olsson
- P-E74 **Atomic and Electronic Structure of Pt/TiO<sub>2</sub> Model Catalysts and Their Relationship to Catalytic Activity**  
H. Hojo, M. Gondo, S. Yoshizaki, and H. Einaga
- P-E75 **Elucidation of Annealing Effect on a Laser-irradiated ZnO Substrate Surface by Transmission Electron Microscope**  
K. Nagami, X. Yu, T. Ishida, K. Saitoh, and M. Kuwahara
- P-E76 **In Situ Liquid TEM Studies of Polymerization of Organic Electrochemical Transistors**  
R. Rilemark, L. Zeng, B. Granroth, D. Priyadarshini, J. Gerasimov, M. Berggren, and E. Olsson