

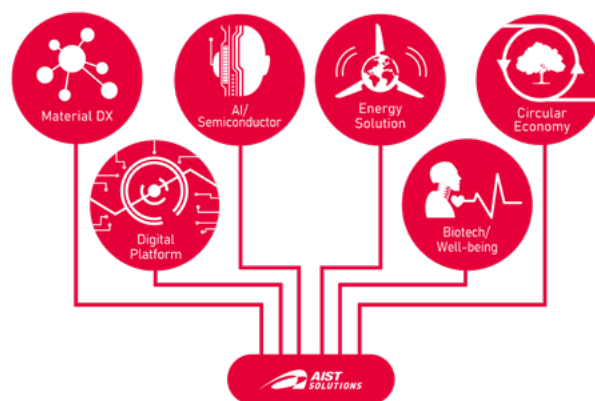
## Establishment of AIST Solutions

National Institute of Advanced Industrial Science and Technology (AIST) founded the AIST Solutions Co. (AISol) on 1st April 2023. AISol addresses significant social challenges while also enhancing industrial competitiveness. AISol is owned entirely by AIST—a strategic move aimed at reinforcing both the system and efforts for the social implementation of research achievements.

AISol focuses on six primary business areas, each leveraging the innovative technologies of AIST: “Energy Solution,” “AI/Semiconductor,” “Circular Economy,” “Material DX,” “Biotech/Well-being,” and “Digital Platform.”

As one of the largest national research institutes in Japan, AIST actively promotes open innovation, fosters a national innovation ecosystem, and creates new business value through proactive marketing activities.

### Six business areas focused by AIST Solutions



<https://www.aist-solutions.co.jp/>

## Greetings from Prime Senior Researcher



**Dr. KURAMOTO Naoki**

Prime Senior Researcher  
of Research Institute for  
Engineering Measurement  
(RIEM), NMIJ

In 2019, a noteworthy revision of the definition of the kilogram occurred, marking the first such alteration in 130 years. This seminal revision found its basis in using the Planck constant, representing a significant departure from the previous reliance on a physical artifact. Notably, National Metrology Institute of Japan (NMIJ), AIST, embarked on a dedicated research endeavor spanning five decades to devise a universal definition devoid of artifact dependency. The genesis of this novel kilogram definition was rooted in the meticulous measurement of eight values of the Planck constant, undertaken by national metrology institutes. NMIJ, as an integral participant in the International Avogadro Coordination Project, actively contributed to acquiring four of these eight values. Notably, one of these four values was independently reported by NMIJ (N. Kuramoto et al., *Metrologia* **54**, 716-729, 2017). This collaborative undertaking employed state-of-the-art technologies to establish the new definition of the kilogram. Consequently, the contribution of NMIJ to the redefinition of the kilogram is a historic feat that we can be proud of to the world.

Under the new definition, we can realize the kilogram with extremely high accuracy, playing a pivotal role in determining the consensus value of the kilogram. This consensus value is the present reference of primary mass standards employed by national metrology institutes. Moreover, NMIJ has embarked on developing a technique for accurately measuring small masses, a task hitherto challenging under the previous definition (N. Kuramoto, *Nature Physics* **18**, 720, 2022). NMIJ aspires to contribute to realizing a prosperous world based on the new definition by developing core technologies essential to sustain future industries and societies.

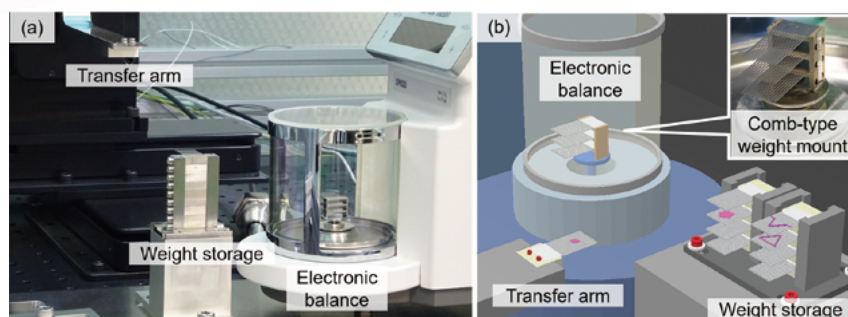
## Research Topics

# Developing an automated mass comparator for sub-milligram weights to achieve the weight calibration with the world's best calibration capability

OTA Yuichi, UEKI Masaaki, KURAMOTO Naoki

In cutting-edge research fields, such as analyzing pollutant particles in air, it is necessary to measure small masses of sub-milligrams with high accuracy. In these studies, it is essential to ensure the reliability of mass measuring instruments by using mass-calibrated weights. Traditionally, at NMIJ, the calibration of the weights involved a comparative process with reference weights using an electronic balance. Conventionally, small weights of less than 1 mg are calibrated by manually transferring the weights to an electronic balance using tools such as tweezers. This procedure, however, causes instability in measuring small weights. Therefore, NMIJ has developed an apparatus for the mass calibration of various shapes of small weights by automatically transporting the weights with a uniquely designed comb-shaped weight mount. This apparatus was used to reduce the variation in the weighing values of the weights to less than half. Thus, it is now possible to calibrate the masses of weights from 100  $\mu\text{g}$  to less than 1 mg with the world's best calibration capability. In March 2021, NMIJ started a mass calibration service for the weights using this apparatus.

Reference: Y. Ota et al., *Measurement* **198**, 111320, 2022, DOI: 10.1016/j.measurement.2022.111320

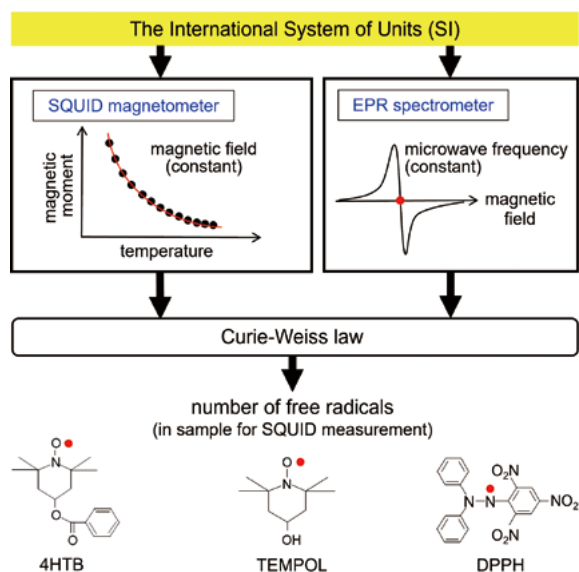


(a) Developed mass comparator for sub-milligram weights with automatic transfer system  
(b) Automatic transfer of a small weight by the developed apparatus

## Effective magnetic moment method based on Curie-Weiss law

MATSUMOTO Nobuhiro

The "primary direct method for amount-of-substance" can directly obtain the amount of substance or amount of substance fraction based on the International System of Units (SI) without referring to any reference material. However, only three primary direct methods include gravimetry, coulometry, and freezing-point depression. This study proposed an "effective magnetic moment method" based on the Curie-Weiss



Purity evaluation of organic free radical reagents by effective magnetic moment method

law, which is related to the temperature variation of magnetism for a paramagnetic substance. The proposed method applies to a compound that includes an unpaired electron in a diamagnetic matrix and quantifies the number of free spins originating from the unpaired electrons. Therefore, this method emerges as a valuable tool for assessing the purity of rare-earth compounds, transition metal compounds, and organic free-radical compounds. As a practical case, the number of free radicals (free spins) included in the stable pure free radical reagent was accurately obtained by measuring the temperature dependence of the magnetic moment using a superconducting quantum interference device (SQUID) magnetometer and by measuring the resonant magnetic field when a microwave was irradiated, using an electron paramagnetic resonance (EPR) spectrometer. The purity of each reagent was evaluated depending on the number of free radicals.

Reference: N. Matsumoto et al., *Anal. Chem.* **94**, 12595, 2022, DOI: 10.1021/acs.analchem.2c01005



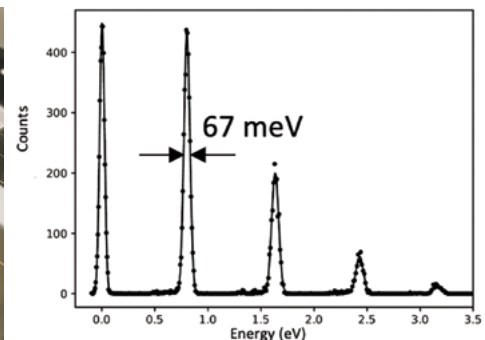
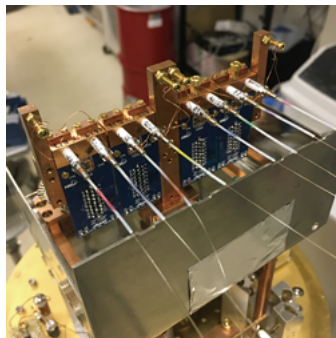
## Optical transition-edge sensor with high energy resolution

HATTORI Kaori

We successfully developed superconducting transition-edge sensors (TESs) that harness the superconducting characteristics of metals at low temperatures. The TESs exhibited remarkable detection efficiency and possessed the capacity to discern a wide spectrum of photons, spanning from visible to near-infrared wavelengths. Furthermore, precise energy measurement of each photon became possible by detecting a minute temperature increase induced by photon absorption within the sensor. Therefore, the TESs empowered spectroscopic measurements at the single-photon level. The versatility of TESs positions them as promising candidates for applications across various fields, including multicolor bioimaging and optical information communication.

Sensors that simultaneously measure photons of different wavelengths, such as those used in bioimaging and spectral measurements, must have high energy resolution. Notably, TESs are theoretically expected to achieve the highest energy resolution of approximately 50 meV. However, practical realization had hitherto eluded this aspiration, with energy resolutions higher than 100 meV. We accomplished a significant breakthrough by reducing the superconducting transition temperature from the conventional value of 300 mK to 115 mK. This achievement culminated in an enhanced energy resolution of 67 meV. We will further investigate the factors determining the energy resolution and aim for even higher resolution levels.

Reference: K. Hattori et al., *Supercond. Sci. Technol.* **35**, 095002, 2022,  
DOI:10.1088/1361-6668/ac7e7b

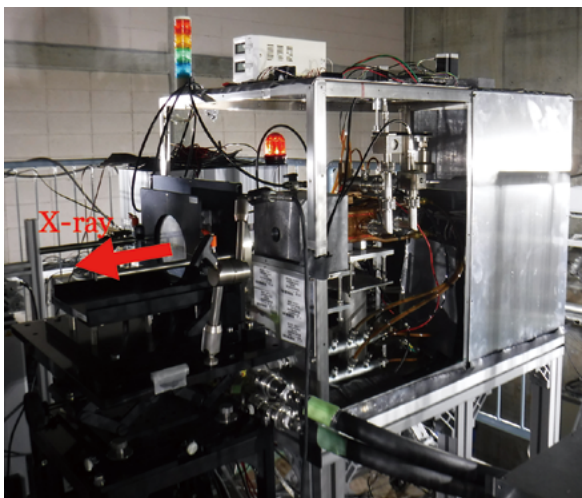


Transition-edge sensor modules (left) and spectra from the pulsed laser (right)

## Developing dose reference field using a compact accelerator

ISHII Junya, SATOH Daisuke, FUJIWARA Takeshi, TANAKA Masahito,  
KATO Masahiro, KUROSAWA Tadahiro

Currently, the maintenance of irradiation equipment using high-intensity radioisotopes (RI) for the calibration of dosimeters poses formidable challenges with respect to nuclear security, safety management, and cost considerations. Hence, we diligently pursued the development of a novel reference field to calibrate the dosimeter response using a compact accelerator that was developed independently as a radiation source, effectively supplanting the need for RIs. The accelerator-driven calibration system does not require an RI with a temporal decay in the radiation intensity. Therefore, the proposed technique enables safer and more continuous operation of a dosimeter calibration facility.



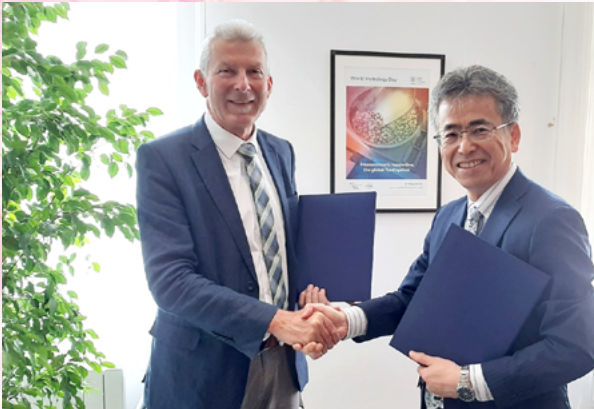
Accelerator-driven replicated Cs-137  $\gamma$ -ray irradiation system

NMIJ constructed a new radiation field using an accelerator with a maximum energy of less than 1 MeV coupled with energy adjustment filters. The developed radiation field was meticulously designed to mirror the characteristics of the Cs-137  $\gamma$ -ray field (662 keV), a widely employed standard for calibrating dosimeters. We verified that the dosimeter responses recorded within this field exhibited agreement within acceptable margins of uncertainty when compared to those derived from the conventional Cs-137  $\gamma$ -ray field. We expect to develop another reference field replicating gamma rays from Co-60 (average 1.25 MeV) by increasing the accelerator energy. Such endeavors will reinforce the reliability and comprehensiveness of our calibration method.

Reference: J. Ishii et al., *Metrologia* **60**, 042101, 2023,  
DOI: 10.1088/1681-7575/acd8c0

## Featured Topics

### Conclusion of a Memorandum of Understanding between the Federal Institute of Metrology, Switzerland, and NMIJ



Dr. Philippe Richard of METAS (left) and Dr. USUDA Takashi of NMIJ (right)

On 22nd June 2023, Dr. Philippe Richard, Director of the Federal Institute of Metrology (METAS), Switzerland, and Dr. USUDA Takashi, Director General of NMIJ, signed a specific memorandum of understanding (MOU) between the two institutes at the International Bureau of Weights and Measures in Sèvres, France. During their visit to the International Committee for Weights and Measures, this agreement was solidified.

METAS, the national metrology institute of Switzerland, will now collaborate closely with NMIJ as outlined in the MOU. This partnership will particularly focus on advancing their technical capacities in areas such as quantum sensing and quantum technology, the kibble balance, and particle metrology.

### Visit of a Delegation from the National Institute of Standards and Technology, USA, to NMIJ

On 15th May 2023, a delegation from the National Institute of Standards and Technology (NIST, USA) paid a visit to NMIJ. The delegation included Dr. James Olthoff, Chief Metrologist; Dr. James Kushmerick, Director of the Physical Measurement Laboratory; and Dr. Claire Saundry, Director of the International and Academic Affairs Office. They were welcomed by Dr. USUDA, alongside Dr. KOBATA Tokihiko, Deputy Director General of NMIJ, and Dr. AKOSHIMA Megumi, Manager of the Research Planning Office of NMIJ, along with other members of NMIJ team.

Dr. USUDA delivered a welcoming address and provided an insightful overview of NMIJ. This was followed by a scientific presentation by a researcher from NMIJ, after which the visitors were given a tour of NMIJ's research laboratories where the team displayed their latest research activities. After the tour, lively discussions and exchange of opinions took place.



A group photo at NMIJ

From center to right: Dr. Olthoff, Dr. Kushmerick, and Dr. Saundry from NIST

### Visit of a Delegation from the Department of Science Service, Thailand, to NMIJ



A photo during the tour at NMIJ

Far right: Ms. Chaimanee, Deputy Director General of DSS

NMIJ received a visit of a delegation led by Ms. Pattariya Chaimanee, Deputy Director General of the Department of Science Service (DSS), a prominent national scientific organization operating under the Ministry of Higher Education, Science, Research and Innovation. Dr. USUDA, alongside fellow NMIJ members, extended a warm welcome to the visiting delegation. During the two-day visit on 4th and 5th September 2023, DSS gave a presentation on future research strategies, and took a tour of the relevant NMIJ research laboratories.

The roots of the collaboration trace back to 2015, when NMIJ and DSS initially formalized their relationship through a letter of intent, which subsequently paved the way for ongoing technical exchanges. Expanding the scope of their cooperation to encompass the entire field of metrology, both institutions expect to build cooperative relationships.



## Celebrating the 120th Anniversary of the Central Inspection Institute of Weights and Measures

Founded in December 1903, the Central Inspection Institute of Weights and Measures, which later became NMIJ, initiated the dissemination of modern measurement standards throughout Japan. As we approach 2023, we celebrate the 120th anniversary of the formal establishment of these standards. Over the years, this central organization for standardized measurement technologies has played a pivotal role in shaping the nation's industrial and scientific landscape, thereby contributing significantly to both economic growth and scientific advancements.

After undergoing two name changes, the Central Inspection Institute of Weights and Measures transitioned into the National Research Laboratory of Metrology in 1961. During this period, the institute relocated from Ginza in Chuo-ku to Itabashi-ku, Tokyo. Later, in 1979, it moved again from Itabashi-ku to Sakura-mura, Niihari-gun (now Tsukuba City), Ibaraki. In April 2001, a significant restructuring of central government ministries led to the establishment of the National Institute of Advanced Industrial Science and Technology (AIST). This reorganization resulted in the merger of various entities, including the National Research Laboratory of Metrology and the Weights and Measures Training Institute, as well as relevant departments from the Electrotechnical Laboratory and the National Institute of Materials and Chemical Research. This merger culminated in the formation of NMIJ, which now serves as the central hub for the integrated and comprehensive implementation of measurement standards within the fields of physics, electricity, and chemistry. Currently, NMIJ comprises four Research Institutes, the Center for Quality Management of Metrology, the Research Planning Office of NMIJ, and the Collaboration Promotion Office of NMIJ.

NMIJ is committed to advancing measurement standards, refining measurement and analysis technologies, and ensuring the reliability of measurements used in commercial transactions within the realm of legal metrology. For further insight, you can explore the special 120th-anniversary page (<https://unit.aist.go.jp/nmij/english/info/120th/>) on the NMIJ website.



Relocating operations from Itabashi-ku, Tokyo, to Sakura-mura, Niihari-gun (now Tsukuba City), Ibaraki, in 1979



The Central Inspection Institute of Weights and Measures, established in 1903 on the premises of the Ministry of Agriculture and Commerce (Kobiki-chou, Kyobashi-ku, Tokyo-shi, now known as Ginza, Chuo-ku, Tokyo)

## National Conference of Standards Laboratories International Workshop and Symposium 2023

The National Conference of Standards Laboratories International Workshop and Symposium, titled "Understanding Climate Change through Metrology," was held from the 8th to the 12th of August, 2023, at the Rosen Shingle Creek Hotel and Convention Center in Orlando, Florida, USA. During this year's event, NMIJ established a booth in the exhibit hall, and one of the NMIJ staff members participated actively on-site.

Prominent counterparts were also present, including NIST from the USA, NRC from Canada, and NPL from the UK each displaying their respective booths at the event.



NCSLI Orlando 2023

## International Commission on Radiation Units and Measurements Symposium

The International Commission on Radiation Units and Measurements (ICRU) Symposium was held on 19th April 2023, at the Iwaki Washington Hotel in Iwaki, Fukushima, Japan. This collaborative event was organized by the Fukushima Institute for Research, Education, and Innovation, NMIJ, and the ICRU. Established in 1925, the ICRU is well-known for developing and promulgating internationally accepted recommendations on radiation-related quantities and units, terminology, measurement procedures, and reference data for the safe and efficient use of ionizing radiation in medical applications, radiation science and technology, and radiation protection. Both online and in-person formats were adopted for this symposium, attracting 60 individuals



Dr. Vincent Grégoire, ICRU Chairman

in person and 116 participants online. The event, titled "Revitalization of Fukushima and Radiation Measurement," featured presentations and insightful discussions led by two ICRU commissioners and four Japanese experts. Among the various presentations, Dr. KUROSAWA Tadahiro from NMIJ reported on establishing low-dose-rate calibration methods for environmental monitoring. We extend our sincere gratitude to the Reconstruction Agency, the Ministry of Economy, Trade, and Industry, the sponsoring organizations, and all stakeholders who played a pivotal role in facilitating the ICRU Annual Meeting in Japan and orchestrating this symposium.

[https://unit.aist.go.jp/nmij/public/events/seminar/2023/ICRU\\_symposium/](https://unit.aist.go.jp/nmij/public/events/seminar/2023/ICRU_symposium/)

## Introduction of Asia Pacific Metrology Programme Technical Committee for Thermometry

The Asia Pacific Metrology Programme (APMP) is comprised of 12 Technical Committees (TCs), including the Technical Committee for Thermometry (TCT), which focuses specifically on activities related to the measurement standards of temperature, humidity, and thermophysical quantities. The chairs of the TCs, elected from the full member economies of the APMP, typically serve a three-year term. I assumed the role of TCT chair following the APMP General Assembly in November 2021 and have assumed the responsibility of leading this committee.

A primary objective of each economy's National Metrology Institute is to have their Calibration and Measurement Capabilities (CMCs) objectively and internationally recognized and registered in the database (KCDB) maintained by the International Bureau of Weights and Measures. The TCT plays a pivotal role in supporting this activity. Close collaboration with pertinent TCT members in international comparisons, CMC reviews, and on-site peer reviews are essential for achieving CMC registration and ensuring smooth progress, which remains a key focus for the TCT chair.

The scope of TCT's engagements encompasses diverse areas, including planning and updating the progress of international comparisons among multiple economies, addressing complex issues involving multiple economies, and deliberating on the future direction of the TCT itself. While email discussions have limitations, our annual APMP meeting assumes a pivotal role, providing TCT members with a platform for intensive in-person discussions. Recently, owing to the COVID-19 pandemic, these meetings have transitioned to remote formats. However, with the gradual improvement of the situation, there is optimism about the return to traditional face-to-face gatherings, facilitating more effective and lively discussions.



2023 APMP Mid-Year Meeting



Dr. ABE Hisashi

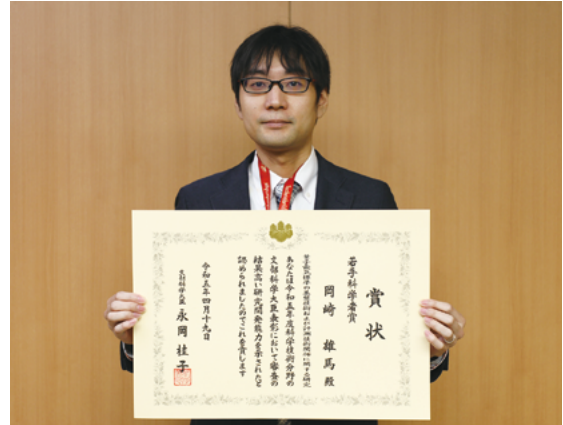
Since taking on the role of TCT chair, a substantial portion of my time has been devoted to TCT-related issues, and the challenges still persist. However, the satisfaction derived from successfully troubleshooting underscores the significance of our collective accomplishments.



## Young Scientists' Award

Dr. OKAZAKI Yuma, senior researcher in the Quantum Electrical Standards research group at the Research Institute for Physical Measurement (at the time of the experiments), has been honored with the 2023 Young Scientists' Award. This esteemed recognition, the Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology, celebrates his exceptional contributions under the title "Research on foundation and application of the quantum electric standards." In the revised SI system of 2019, the unit of electric current (Ampere) underwent redefinition from the quantum mechanics perspective. This revision established a more universally applicable and consistent framework for their characterization. The newly revised electric units rely on the manipulation and precise measurement of quantum states related to electrons, encompassing single electrons and quantized resistance. Consequently, the urgent development of their experimental bases is needed.

This research aims to establish the fundamental principles of quantum electric standards and their practical measurement applications. These applications encompass inventing a novel variant of the quantum AC current standard, implementing a recently uncovered topological insulator for a resistance standard, and demonstrating the remarkable sensitivity of quantum-dot-based vibration sensors. Collectively, these studies form the foundation to achieve highly precise and reliable electrical measurements, thereby strengthening the reliability and reproducibility of advancements in science and technology.



Dr. OKAZAKI Yuma

Reference: Y. Okazaki et al., *Nature Physics* **18**, 25, 2022,  
DOI: 10.1038/s41567-021-01424-8

## Technical consulting for the Saudi Standards, Metrology, and Quality Organization

Sixteen officials from the Saudi Standards, Metrology and Quality Organization (SASO), the legal metrology organization of Saudi Arabia, visited Japan between 29th May and 10th June 2023, to learn about the Japanese metrology system. NMIJ secured a contract from the Japan Measuring Instruments Federation (JMIF) to act as a technical consultant for AIST Solutions, Co.

The metrology official of the Ministry of Economy, Trade and Industry (METI) and technical experts of Tatsuno Corporation gave lectures regarding the Japanese Measurement Act, structure and latest topics.

The primary focus of consultation was to guide the type approval testing of water meters and software inspection methods based on OIML D 31. A notable feature of this consultation was that participants were not only subjected to lectures but also immersed in practical learning within NMIJ's facilities. This hands-on approach enabled them to experience firsthand the testing and inspection procedures, effectively simulating the tasks they would perform upon returning to SASO.

In addition to NMIJ, tours were conducted at the Japan Electric Meters Inspection Corporation (JEMIC), the Tokyo Metropolitan Industrial Technology Research Institute (TIRI), the Tokyo Metropolitan Government Bureau of Waterworks, Aichi Tokei Denki Co., Ltd., and Osaki Electric Co., Ltd.



A group photo with SASO officials, NMIJ experts and JMIF staff at NMIJ

## Selected Research Reports

- 1) T. Muramoto, Y. Ito, A. Miyakawa, N. Furuichi, "Strain and Stress Accumulation in Viscoelastic Splay Fault and Subducting Oceanic Crust," *Geophysical Research Letters* **50**, e2023GL103496, 2023, DOI: 10.1029/2023GL103496
- 2) T. Morioka, "Performance Evaluation Test of Coriolis Flow Meters for Hydrogen Metering at High Pressure," *Measurement* **221**, 113549, 2023, DOI: 10.1016/j.measurement.2023.113549
- 3) T. Yoshida, N. Furuichi, "Efficacy Assessment of Controllable Volumetric Prover for Quantifying the Responsiveness of Various Flowmeters," *Measurement* **220**, 113369, 2023, DOI: 10.1016/j.measurement.2023.113369
- 4) Y. Kano, "Thermophysical Properties Evaluation for a Polar Fluid on the Basis of the Experimentally Determined Heat Capacity and Dipole Moment in the Ideal Gas States," *Journal of Thermal Analysis and Calorimetry* **148**, 5573, 2023, DOI: 10.1007/s10973-023-12118-z
- 5) K.-H. Cheong, R. Doihara, N. Furuichi, M. Nakagawa, R. Karasawa, Y. Kato, K. Kageyama, T. Akasaka, Y. Onuma, T. Kato, "Measurement of the Infusion Flow Rate of a Novel Non-Electrically Driven Infusion Pump in Determining the Influencing Factors on its Flow Performance," *Measurement* **218**, 113229, 2023, DOI: 10.1016/j.measurement.2023.113229
- 6) K. Amemiya, Y. Shimizu, H. Koshikawa, H. Shitomi, T. Yamaki, "Supreme-Black Levels Enabled by Touchproof Microcavity Surface Texture on Anti-Backscatter Matrix," *Science Advances* **9**, eade4853, 2023, DOI: 10.1126/sciadv.ade4853
- 7) Y. Kato, K. Yonemura, K. Seki, R. Kambara, A. Sanada, "Reconfigurable Anomalous Reflectors with Stretchable Elastic Substrates at 140 GHz Band," *Nanophotonics* **12**, 2527, 2023, DOI: 10.1515/nanoph-2022-0758
- 8) K. Niwa, H. Kubota, T. Enomoto, Y. Ichino, Y. Ohmiya, "Quantitative Analysis of Bioluminescence Optical Signal," *Biosensors* **13**, 223, 2023, DOI: 10.3390/bios13020223
- 9) M. J. Yamamoto, Y. Tojima, M. Kinoshita, "Quantum Measurement of Radio-Frequency Attenuation Based on Atomic Resonance," *IEEE Transactions on Instrumentation and Measurement* **72**, 8004408, 2023, DOI: 10.1109/TIM.2023.3296130
- 10) S. Nakamura, D. Matsumaru, G. Yamahata, T. Oe, Y. Okazaki, S. Takada, M. Maruyama, A. Fujiwara, N. Kaneko, "Cryogenic Operation of Electromechanical Relay for Reversal of Quantized Current Generated by a Single-Electron Pump," *IEEE Transactions on Instrumentation and Measurement* **72**, 1502809, 2023, DOI: 10.1109/TIM.2023.3290995
- 11) E. Yamazaki, H. Eun, S. Taniyasu, T. Sakamoto, N. Hanari, H. Inui, R. Wu, H. Lin, P. K.S. Lam, J. Falandysz, N. Yamashita, "Residue Distribution and Daily Exposure of Per- and Polyfluoroalkyl Substances in Indica and Japonica Rice," *Environmental Science & Technology* **57**, 4208, 2023, DOI: 10.1021/acs.est.2c08767
- 12) M. Furukori, Y. Nagamune, Y. Nakayama, T. Hosokai, "High-Throughput Transient Photoluminescence Spectrometer for Deep Learning of Thermally Activated Delayed Fluorescence Materials," *Journal of Materials Chemistry C* **11**, 4357, 2023, DOI: 10.1039/D3TC00482A
- 13) S. Takeya, H. Fujihisa, S. Alavi, R. Ohmura, "Thermally Induced Phase Transition of Cubic Structure II Hydrate: Crystal Structures of Tetrahydropyran-CO<sub>2</sub> Binary Hydrate," *Journal of Physical Chemistry Letters* **14**, 1885, 2023, DOI: 10.1021/acs.jpcllett.2c03392
- 14) T. Hosokai, J. Nomoto, "The Real-Time Monitoring of the Laser-Induced Functionalization of Transparent Conductive Oxide Films," *Nanomaterials* **13**, 2706, 2023, DOI: 10.3390/nano13192706
- 15) S. Yamashita, S. Miyashita, T. Hirata, "Size Uncertainty in Individual Nanoparticles Measured by Single Particle Inductively Coupled Plasma Mass Spectrometry," *Nanomaterials* **13**, 1958, 2023, DOI: 10.3390/nano13131958
- 16) P. Xia, S. Ri, "Three-Dimensional Phase Measurement of Transparent Gas by High-Speed Digital Holographic Tomography System," *Optics and Lasers in Engineering* **168**, 107656, 2023, DOI: 10.1016/j.optlaseng.2023.107656
- 17) H. Kimura, T. Kato, T. Fujiwara, M. Tanaka, G. Okada, D. Nakauchi, N. Kawaguchi, T. Yanagida, "Optical and Photostimulated Luminescence Properties of Eu:BaFBr Translucent Ceramics Synthesized by SPS," *Ceramics International* **49**, 15315, 2023, DOI: 10.1016/j.ceramint.2023.01.115
- 18) D. Asakawa, "Phenyl Sulfate Derivatives: New Thermometer Ions for Characterization of Internal Energy of Negative Ions Produced by Electrospray Ionization," *Journal of the American Society for Mass Spectrometry* **34**, 435, 2023, DOI: 10.1021/jasms.2c00321
- 19) N. Sei, H. Zen, H. Ohgaki, "Deformation of an Electron Bunch Caused by Free-Electron Lasers," *Physica Scripta* **98**, 025510, 2023, DOI: 10.1088/1402-4896/acb253
- 20) J. Ishii, D. Satoh, T. Fujiwara, M. Tanaka, M. Kato, T. Kurosawa, "Accelerator-Driven Photon Reference Field for Replacement of <sup>137</sup>Cs  $\gamma$ -ray," *Metrologia* **60**, 042101, 2023, DOI: 10.1088/1681-7575/acd8c0