NMIJ Newsletter
No.8, November 2018

Greeting from Director of CQMM

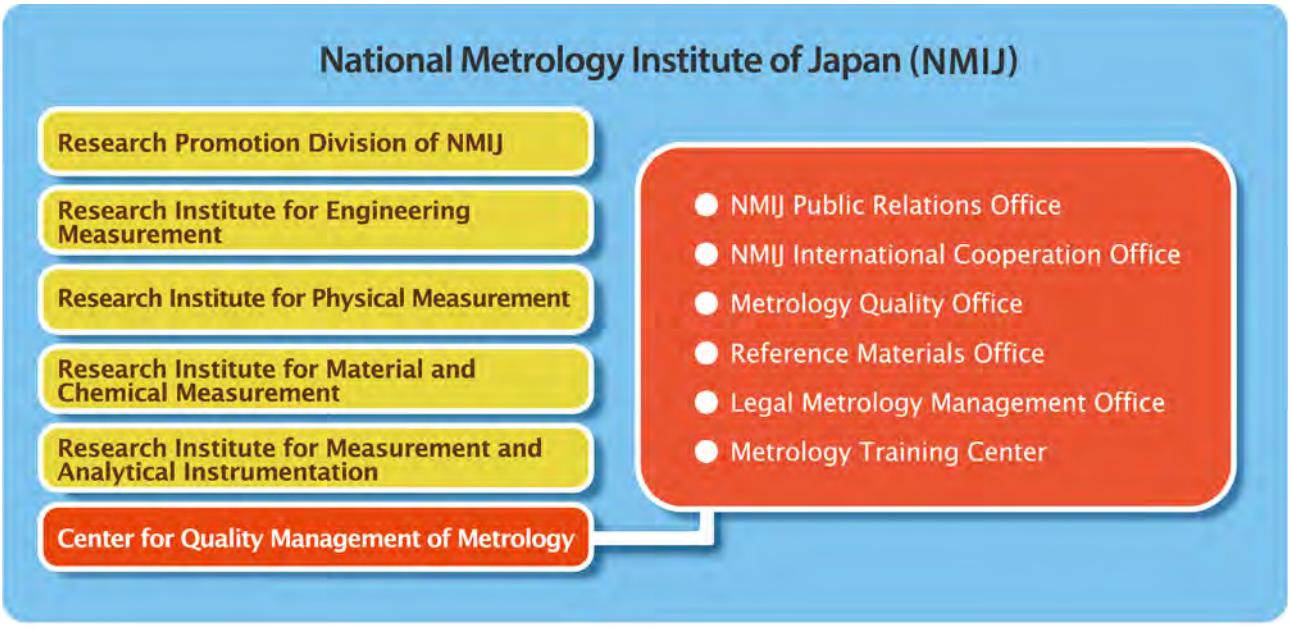
Dr. Tokihiko Kobata
Director of CQMM

Center for Quality Management of Metrology (CQMM) is processing administrative support tasks in NMIJ. CQMM plays a role of promoting the results of activities related to metrology and measurement to our society while ensuring dissemination of measurement standards. CQMM performs the following activities to ensure the quality of metrological traceability in Japan: public relations, collaboration with international organizations and national metrology institutes, calibration and testing services, certified reference material distribution, cooperation with central and local governments to ensure the national legal metrology system, and training for metrology experts.

CQMM consists of six sections: i) NMIJ Public Relations Office is responsible for general coordination, needs assessment survey, promotion activities and development planning regarding measurement standards, ii) NMIJ International Cooperation Office is responsible for international activities, working toward international mutual recognition of measurement standards and legal metrology under the Meter Convention and the International Organization in Legal Metrology (OIML) Convention, iii) Metrology Quality Office is responsible for customer relations for calibration/testing services and quality management on the NMIJ calibration/testing activities, iv) Reference Materials Office is responsible for administration of certified reference materials, and promotion of end support for the NMIJ quality assurance system in the chemical standard groups, v) Legal Metrology Management Office is responsible for technical consultation, technical training and international activities in legal metrology and vi) Metrology Training Center is responsible for training on legal metrology and measurement standards; technical training in metrology to trainees from developing countries.

As described above, CQMM is providing a wide variety of services and information relating metrology and measurement directly to domestic and international customers, metrology experts, private companies and metrological institutes.

For more information, please visit our website: https://www.nmij.jp/english/info/center/



Introduction of CQMM

■ NMIJ Public Relations Office (NMIJ PRO)

NMIJ PRO is responsible for planning, public relations and general affairs of NMIJ.

1. Development of intellectual infrastructure

NMIJ PRO provides the services related to the development and progress management of the intellectual infrastructure development plan, and dissemination activities of measurement standards.

2. Public relations activities of NMIJ

NMIJ PRO held several seminars on the topics of the SI redefinition, in which Dr. Martin Milton (Director of BIPM), Dr. Gert Rietveld (Chief Metrologist of VSL, President of CCEM) and Dr. Duan Yuning (Vice Director of NIM, President of CCT) were invited this year.

■ NMIJ International Cooperation Office (NMIJ ICO)

NMIJ ICO is responsible for international activities of NMIJ based on the Meter Convention and the OIML Convention, and communicating with international metrology organizations and other NMIs.

1. Promotion of international equivalence in metrology

To promote the CIPM MRA and the OIML Certification System (OIML-CS), the office supports international conventions, comparisons and peer reviews, and hosts domestic metrology committees.

2. Collaboration with other NMIs

NMIJ ICO hosts regular meetings with other NMIs and organizes research collaborations and training courses.

3. International public relations

NMIJ ICO issues an NMIJ newsletter and metrology booklets, and also welcomes guests and visitors from overseas.

■ Metrology Quality Office (MQO)

MQO's mission is to underpin NMIJ's activities as the social infrastructure for the field of metrology.

1. Role of MQO

MQO is establishing and operating the Quality Management System for the calibration/testing services performed by the research institutes in NMIJ related to scientific metrology and legal metrology to demonstrate NMIJ's mutual equivalence under the CIPM MRA and the OIML-CS. MQO also serves as a customer service office that accepts applications and issues certificates for these services.

2. Customer Services

•Verification, Inspection, Type approval testing, Calibration services under the Measurement Act of Japan.
•Testing/calibration services for special needs and proficiency tests.

■ Reference Materials Office (RMO)

RMO is responsible for the distribution of NMIJ Certified Reference Materials (CRMs) and their quality assurance.

1. Distribution and administration of NMIJ CRMs

RMO is distributing and administrating NMIJ CRMs for customers. RMO complies with the related laws for safety of CRMs and maintains the quality of storage.

2. Operation of the Quality Management System

RMO is establishing and operating the Quality Management System for NMIJ CRMs. NMIJ CRMs are produced in compliance with the Quality Management System which meets the requirements of ISO Guide 34 (ISO 17034). NMIJ CRMs, therefore, are internationally authorized. RMO serves to enhance the reliability for the NMIJ CRMs.

■ Legal Metrology Management Office (LMMO)

LMMO coordinates activities in legal metrology conducted by NMIJ.

1. Liaison in Legal Metrology

LMMO cooperates and coordinates activities among NMIJ legal metrology groups, METI (Ministry of Economy, Trade and Industry) and local governments regarding type approval and technical consultation.

2. International activities

LMMO supports OIML and APLMF by coordinating domestic activities to be compliant with recommendations by these organizations.

3. Technical training

LMMO cooperates with Metrology Training Center through providing lectures, sending consultants and coordinating legal metrological seminars, etc.

■ Metrology Training Center (MTC)

MTC provides a place and opportunity for personnel to acquire knowledge about metrology and new technologies for measurement.

1. Aim of MTC

MTC's primary aim is to improve the technical abilities of public workers engaged in metrology-related administration in prefectures and designated municipalities, and also provide training for prospective general certified measurers and environmental certified measurers.

2. Training courses

Under the Measurement Act of Japan, MTC provides various training courses concerning legal metrology and other subjects necessary to carry out metrology-related services, such as the Measurement Act, the principle of measurement and legal metrology systems.

NMIJ International Metrology Symposium (Promotion Activities)

NMIJ Certified Reference Materials

Training for environmental measurement engineers

Column

NMIJ Universal Calibrator Set for Quantitative NMR

Toshiyuki Fujimoto and Takeshi Saito

The NMIJ is pleased to announce the availability of seven Certified Reference Materials (CRMs) for use as internal standards for quantitative NMR (qNMR), for the value assignment of chemical purity. These standards provide a laboratory with a set of universal qNMR calibrators that enables SI traceable purity measurements of organic compounds using qNMR in a range of commonly used solvents.

The available qNMR calibrator reference materials are:

NMIJ CRM

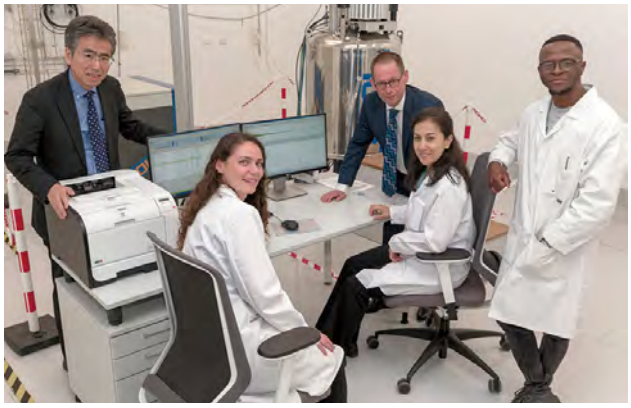
- potassium hydrogen phthalate
- 3,5-Bis(trifluoromethyl)benzoic acid
- 1,4-Bis(trimethylsilyl)-2,3,5,6-tetrafluorobenzene

NMIJ Traceable CRM

- maleic acid
- dimethyl sulfone
- 1,4-Bis(trimethylsilyl)benzene-d_4
- trimethylsilyl propanesulfonic acid sodium salt-d_6

The NMIJ has been developing high-order SI traceable certified reference materials as internal standards for qNMR, as well as supporting commercial chemical reagent producers to develop SI traceable CRMs through its calibration services. The NMIJ Traceable CRMs listed above are available from FUJIFILM Wako Pure Chemical Corporation.

The reference materials have also been used to support a collaboration, started in 2014, with the International Bureau of Weights and Measures (BIPM) to improve the accuracy of qNMR methods, their traceability to the SI and the reference data for the use of internal standards/calibrators for qNMR. Further information on qNMR Internal Standard Reference Data (ISRD), which is publicly and freely available, can be found at:
https://www.bipm.org/en/news/full-stories/2018-04/2018-03-isrd.html



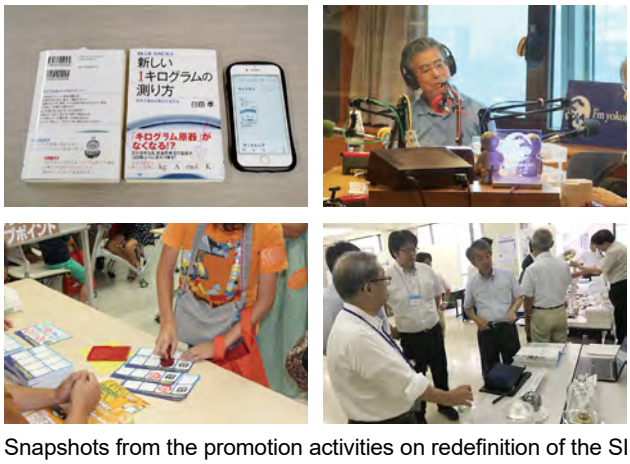
Directors of the BIPM and the NMIJ together with visiting scientists to the qNMR laboratory at BIPM

Promotion Activities on Redefinition of the SI

Naoyuki Taketoshi

In order to have many people know the redefinition of the SI, NMIJ carried out various activities during the campaign period, which initiated on the World Metrology Day 2018.

A book titled "How to Measure the New Kilogram", written by Dr. Takashi Usuda, Director General of NMIJ, was published on April 2018. This book is easy for general readers to understand the fact that the definitions of units are also changing as technology advances. This publication has brought a lot of television/radio appearances.



Snapshots from the promotion activities on redefinition of the SI

"The last artifact" is a documentary on redefinition of the mass, which is in production by a US TV production company*. BIPM, NIST, NPL, NRC, PTB and many NMIs have been interviewed so far. Filming in NMIJ was on June 2018 and it took over a week, introducing instruments to measure the Avogadro constant and interviewing related researchers.

AIST Open Campus Tsukuba was held for general public to get familiar with science on 21st July 2018. The theme of this year was “Measurement”. Various events such as a talk event on redefinition of the SI with high school students, Stamp Rally of base units and other games to experience measurement were offered. NMIJ Prime Senior Researchers, Dr. Kenichi Fujii, Dr. Nobu-Hisa Kaneko and Mr. Yoshiro Yamada, comprehensibly explained the redefinitions of the kilogram, the ampere and the kelvin respectively.

High school teachers are also subject of the promotion activities. The NMIJ participated in an exhibition in conjunction with Plenary meeting of Japanese science education at high schools from 9th to 10th August 2018. Many high school science teachers, especially on physics and chemistry, visited our booth to know more about the redefinition of the SI.

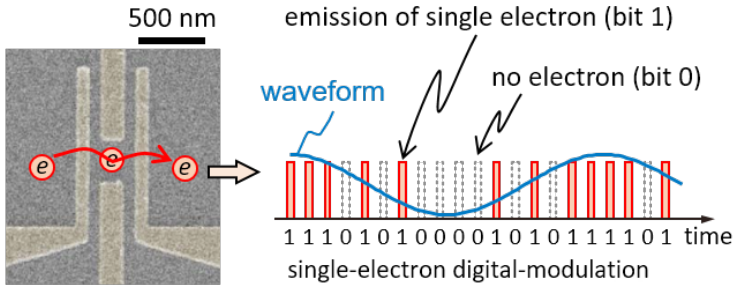
* https://www.thelastartifactfilm.com

Research topics

Single-electron digital modulation for arbitrary waveform current generation

Yuma Okazaki, Shuji Nakamura, and Nobu-Hisa Kaneko

The ampere is the base unit of electric current and can be defined as the number of electrons flowing through a conductor in one second. Using nano-fabricated single-electron transistors (left figure), by which single-electrons can be electrically detected, manipulated and directly pumped, highly accurate dc current can be generated. In contrast to the dc current generation, with which an error rate down to the 0.1 parts per million level has already been demonstrated, the generation of precise finite-frequency currents has remained challenging. Recently we developed a new operation scheme of single-electron pumping, where the pump event is digitally modulated to generate a density-modulated single-electron stream, which we refer to as single-electron digital modulation (right figure). By this scheme, arbitrary waveforms of current including sinusoidal, square, and triangular waveforms can be generated. In our experiment, we demonstrated the generation of arbitrary waveform current with a peak-to-peak amplitude of approximately 10 pA and an output bandwidth ranging from dc to 1 MHz. The functionality and calculability offered by this finite-frequency current generator with single-electron digital modulation are suitable for developing new schemes for precision measurements of finite-frequency current which are requested for measurements of current noise, impedance, and sensors etc.



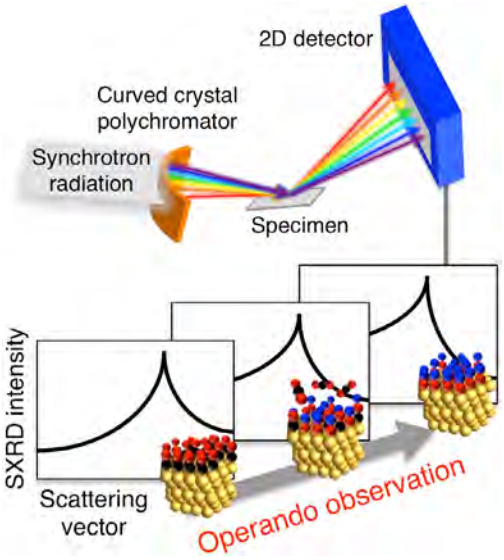
An electron microscope image of our single electron transistor (left) and a schematic of single-electron digital modulation (right)

Reference: Y. Okazaki et al., Applied Physics Express, **11**, 036701, 2018.

Capturing atomic motion of solid-liquid interface during electrochemical reaction

Tetsuroh Shirasawa

Fuel cells and batteries are indispensable energy devices in our daily life, and are regarded as a key technology to realizing the energy-saving society. In the heart of the devices, the electrochemical reaction is occurring at the interface between the solid electrode and liquid electrolyte, which converts chemical energy into electric energy. For the designing of interface with higher energy conversion efficiency, a deep understanding of the electrochemical reaction is demanded.



Energy-dispersive SXRD for real-time monitoring of chemical reactions

In-situ analysis techniques have been developed in the past decades to visualize the interface structure, and many important elementary steps of electrochemical reaction have been revealed. Among them, surface x-ray diffraction (SXRD) is a unique technique for analyzing the atomic structure of interface nondestructively. However, the analysis was often limited to the static structure because the data acquisition required several minutes or more. Capturing the atomic-scale dynamics of electrochemical reaction with a sufficient temporal resolution remained challenging.

We have developed a novel high-speed SXRD system that uses energy-dispersive convergent X-rays and a two-dimensional detector [see the figure at left]. The method allowed a single acquisition of the SXRD dataset within 1 second or less, succeeded in capturing the motion of atomic layer of Pt electrode surface during electrochemical reactions, and opened the way to real-time monitoring of the electrochemical reaction processes.

Reference: T. Shirasawa et al., Journal of Physical Chemistry C, **121**, 24726, 2017.

Featured events

Director of NIM, China, visits NMIJ

On 7th May 2018, Mr. Fang Xiang, Director of the National Institute of Metrology (NIM), China, Ms. Li Hongmei, Director of Division of Metrology in Chemistry and four other delegates visited NMIJ in Tsukuba. A warm welcome to the delegates began with the greetings and remarks by Dr. Yukinobu Miki, Senior Vice-President of AIST and Dr. Takashi Usuda, Director General of NMIJ, continued with presentations on the organization's outline of each institution. In the meeting with NMIJ executives, an exchange of opinions regarding the future action plans was carried out thoroughly and it was agreed to create a "package" for the realization of sustainable research cooperation.

12 representative laboratories have been prepared for the lab tour program. Although it was a tight schedule, the delegates enthusiastically listened to the details of the researches conducted in each lab.

The 20th Anniversary of NIMT

The National Institute of Metrology (Thailand), NIMT, celebrated its 20th anniversary this year. To express the highest respect, Dr. Takashi Usuda, Director General of NMIJ and delegates participated in a series of anniversary ceremonies held by NIMT in Bangkok and Pathumthani Campus from 5th to 8th June 2018. Dr. Usuda delivered a congratulatory message at the event accompanied with the launch of the NMIJ's NIMT Project Booklet* as a memoir. He also received the NIMT Award 2018 presented by the Minister of Science and Technology, Thailand, for the aids and support provided by NMIJ so far. Dr. Toshiyuki Takatsuji, Director of RIEM, participated in the event as a representative of APMP, while Dr. Nobu-Hisa Kaneko, Prime Senior Researcher of RIPM, gave a talk as an invited speaker at the symposium on the SI Redefinition. NIMT is one of the most important partners which has collaborated deeply since the JICA/NIMT project in 2002.

"Congratulations! Hopefully NIMT will be more advanced and successful both as NMI of Thailand and hub-NMI in the ASEAN region."

* https://www.nmij.jp/~imco/en/Publication/NIMT/NIMTproject_jp_th_en_180712.pdf

OIML Training Workshop for Project Group/ Technical Committee's Conveners/Secretariats

The International Organization in Legal Metrology (OIML) is an intergovernmental treaty organization which develops model regulations, standards and related documents for use by the legal metrology authorities and the industry. It issues many international publications under Technical Committee/Sub-Committee/Project Group (TC/SC/PG). Japan is one of the most active OIML members. Dr. Yukinobu Miki, Senior Vice-President of AIST, serves as the Vice President of domestic mirror committee, and submit comments on approximately 30 topics annually.

To train the experts who support this activity, the OIML has been promoting training since 2017. A training workshop for secretaries/conveners of TC/SC/PG was conducted at AIST Tokyo Waterfront from 18th to 19th June 2018. It was the first workshop held in the Asian countries. Mr. Ian Dunmill and Mr. Gilles Vinet were the trainers of OIML's Secretariat. Trainees were fourteen Japanese experts from Ministry of Trade, Economy and Industry (METI), Japan Measuring Instruments Federation (JMIF) and NMIJ including the secretary of TC 8 and the deputy convener of TC 8/SC 7/p 7.

The workshop was composed of lectures on roles of the OIML, rules of drafting documents and directions for the use of members' website. As participants commented, it was a valuable opportunity as they could ask questions freely, which is difficult to do so in official meetings.

APMP Mid-Year Meeting 2018

Standards and Calibration Laboratory (SCL) and Government Laboratory (GL) jointly hosted the APMP Mid-Year Meeting 2018 from 3rd to 6th July 2018 at the Royal Plaza Hotel in Hong Kong, China.

This annual Mid-Year Meeting provides an opportunity for Executive Committee (EC) members, Technical Committee (TC) Chairs and Developing Economies' Committee (DEC) members to discuss related issues, review activities and future plans. Dr. Toshiyuki Takatsuji, Chair of the APMP welcomed all attendees and hosted his second Mid-Year Meeting. A new member of this meeting from NMIJ, Dr. Kazuaki Yamazawa, Manager of Metrology Quality Office of NMIJ/AIST, attended the meeting as Acting Chair of Technical Committee for Quality System (TCQS) since the former TCQS Chair, Dr. Isao Kishimoto, had been promoted to the National Institute of Technology Evaluation (NITE), accreditation body in Japan. In the DEC meeting, 45 participants discussed future activities and matters arising from the previous meeting.

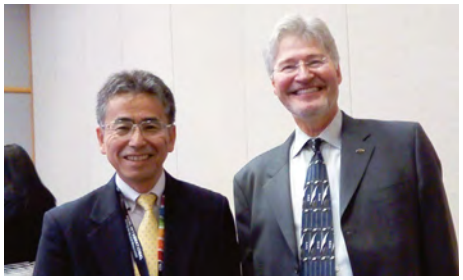
In conjunction with the Mid-Year Meeting, MEDEA Workshop was also held in the Open University of Hong Kong. MEDEA (Metrology-Enabling Development Economies in Asia) is a project organized by PTB (Physikalisch-Technische Bundesanstalt) to build up developing economies' laboratory structure and develop their function and quality using the networks of APMP and APLMF (Asia Pacific Legal Metrology). The opening ceremony was jointly hosted by APMP EC members, TC Chairs and DEC members with MEDEA Workshop participants. 43 participants attended discussion and group workshops and both were completed successfully.

In the joint welcome diner for APMP and MEDEA Project, Dr. Takatsuji entertained all attendees with Bingo Game. Many of the participants joined laboratory tour and visited SCL and then GL on the last day of the meeting.

The 16th NMIJ-KRISS Summit

The NMIJ hosted the 16th NMIJ-KRISS Summit on 10th July in Sapporo, Hokkaido, Japan. Seven delegates from the Korea Research Institute of Standards and Science (KRISS) including Dr. Sang-Ryoul Park, President of KRISS, were welcomed by Dr. Takashi Usuda, Director General of NMIJ, and other NMIJ participants. The current status, R&D activities and strategic plans of each institute were presented, and the progress of their research-cooperation program was reviewed to promote mutual collaboration between NMIJ and KRISS. They also discussed the promotion activities toward the redefinition of the SI unit, advanced instrumentation and quantum technology in both institutes.

2018 NCSLI Workshop & Symposium



The NCSL International (NCSLI) Workshop and Symposium was held from 25th to 30th August 2018 at Oregon Convention Center, Portland, Oregon, the United States, with the theme of "Measurements of Tomorrow", focusing on the coming redefinition of the SI base units.

Dr. Takashi Usuda, Director General of NMIJ, attended the board meeting as the representative of NMIJ. At the meeting, Dr. Usuda met with Dr. Walter G. Copan, Director of the National Institute of Standards and Technology (NIST), and discussed about the research-collaboration between NMIJ and NIST.

The 41st Korea-Japan Cooperation Committee for Legal Metrology

The NMIJ joined the 41st Korea-Japan Cooperation Committee for Legal Metrology held on 10th September at Hotel Hyundai Gyeongju, the Republic of Korea. The 24 participants from the seven institutes, i.e., NMIJ, Ministry of Economy, Trade and Industry (METI) and Japan Electric Meters Inspection Corporation (JEMIC) from Japan, and the Korean Agency for Technology and Standards (KATS), Korea Testing Certification (KTC), Korea Association of Standards and Testing Organizations (KASTO) and Korea Testing Laboratory (KTL) from Korea, exchanged information and discussed future planning of the legal metrology between Korea and Japan. The KTL is a new participant of this committee, and a new cooperation program: "Considerations for smart metering in terms of legal metrology" was agreed to start.

Dr. Duan gives a speech at the 16th Japan Metrology Forum Symposium

Dr. Duan Yuning, Vice Director of the National Institute of Metrology (NIM), China, who also serves as President of the Consultative Committee for Thermometry (CCT) and a member of the International Committee for Weights and Measures (CIPM), was invited by NMIJ to give a keynote speech at “The 16th Japan Metrology Forum Symposium: On the future redefinition of the SI - The kelvin redefinition and the future outlook -” held on 27th September 2018 in Tokyo International Exhibition Center, Tokyo. In his talk, Dr. Duan briefly introduced the progress of the redefinition of the kelvin, then detailed the Mise en Pratique of the definition of the kelvin (MeP-K) and the primary methods to measure thermodynamic temperature. The audience listened intently to his talk and responded with questions. On 26th September, the day before the symposium, Dr. Duan visited NMIJ and was warmly welcomed by NMIJ members including Dr. Takashi Usuda, Director General of NMIJ, by organizing a technical seminar and a lab tour in the Research Institute for Physical Measurement (RIPM) area. Since he has conducted research at NMIJ in the past, he said “It’s like coming back home!”. “Welcome home, Dr. Duan!”

Peer review and International comparisons

The NMIJ dispatches peer reviewers to other NMIs on their requests (if available). In the period from April to September 2018 four researchers from NMIJ visited two NMIs as on-site peer reviewers. Also, NMIJ has participated in the following international comparisons.

NMIJ Participants	KCDB Code	Field	Title	Pilot Lab	Start Date
Dr. K. Arai, Dr. M. Kojima	APMP.N.P-K4	Pressure, 1 Pa to 10 kPa	Comparison of pressure standards	KRISS	07 April 2018
Dr. H. Shitomi	CCPR-K4.2017	Luminous flux	Comparison of luminous flux in lm using tungsten lamps	NMIJ	01 May 2018
Dr. T. Kinumi	CCQM-K115.b/ P55.2.b	Synthetic Oxytosin, OXT	Comparison: Characterization of Peptide Substances for Chemical Purity	BIPM/ NIM	21 May 2018
Mr. Y. Seino, Dr. S. Takagi, Ms. Y. Tanaka, Dr. K. Hattori	APMP.M.H-S6	Hardness, Vickers	Supplementary comparison of Vickers Hardness	NIMT	June 2018
Dr. K. Hattori, Ms. Y. Tanaka	APMP.M.H-S5	Hardness, Brinell	Supplementary comparison of Brinell Hardness	NIMT	July 2018
Dr. H. Itoh		ISO (VAMAS TWA2 Project)	International Round Robin Test for Guidelines for Shape and Size Analysis of Nano-particles by Atomic Force Microscopy	NIMS	10 July 2018
Dr. T. Uchida	APMP.AUV.U-K3	Ultrasonic power	TCAUV/APMP key comparison ultrasonic power	KRISS	13 August 2018

Visitors

Many foreign guests visited NMIJ for technical discussions and a series of training. Ongoing and future collaborations were discussed with the guests listed below.

Name	Affiliation	Visiting Date	Visiting Topic
Ms. Corinna Weigelt	PTB, Germany	06 June 2018	PTB Technical Cooperation in Asia
Dr. Christian Koch	PTB, Germany	17 July 2018	Discussion about airborne ultrasound and ultrasonic power measurement
Dr. Huang, Lu	NIM, China	08 June - 01 Oct. 2018	Particle size measurement by dynamic light scattering method
Dr. Tian Wen, Mr. Liu Tao, Mr. Du Jian	IERM (MEP), China	18 September 2018	Introduction of standard gas preparation methods and gas analysis

Selected research reports

1) R. Kizu, I. Misumi, A. Hirai, K. Kinoshita, S. Gonda, "Development of a metrological atomic force microscope with a tip-tilting mechanism for 3D nanometrology", Measurement Science and Technology, **29**, 075005, 2018
2) A. Hirai, Y. Bitou, Y. Oike, "Evaluation of long-term stability of low thermal expansion coefficient materials using gauge block interferometers", Measurement Science and Technology, **29**, 064014, 2018
3) H. Iizumi, H. Kajikawa, T. Kobata, "Effect of the kind of gas medium on calibration values of high gas pressure transducers", Measurement, **131**, 358-361, 2019
4) T. Hayashi, K. Ueda, "Performance of a stiffened 50 N force comparator referring to a tuning-fork force transducer", Measurement, **121**, 103–108, 2018
5) N. Furuichi, Y. Terao, Y. Wada, Y. Tsuji, "Further experiments for mean velocity profile of pipe flow at high Reynolds number", Physics of Fluids, **30**, 055101, 2018
6) K.-H. Cheong, R. Doihara, T. Shimada, Y. Terao, "Gravimetric system using high-speed double switching valves for low liquid flow rates", Measurement Science and Technology, **29**, 075304, 2018
7) M. Imbe, "Optical configuration with fixed transverse magnification for self-interference incoherent digital holography", Applied Optics, **57**, 2268-2276, 2018
8) M. Tanabe, K. Kinoshita, "Supralinear behavior and its wavelength dependence of silicon photodiodes with over-filled illumination in visible range", Applied Optics, **57**, 3575-3580, 2018
9) T. Tanabe, D. Akamatsu, H. Inaba, S. Okubo, T. Kobayashi, M. Yasuda, K. Hosaka, F.-L. Hong, "A frequency-stabilized light source at 399 nm using an Yb hollow-cathode lamp", Japanese Journal of Applied Physics, **57**, 062501, 2018
10) M. Ohata, K. Nishiguchi, "Research Progress on Gas to Particle Conversion-Gas Exchange ICP-MS for Direct Analysis of Ultra-trace Metallic Compound Gas", Analytical Sciences, **34**, 657-666, 2018
11) C. Cheong, Y. Yamauchi, T. Miura, "Determination of Dissolved Silica in Seawater by Ion-exclusion Chromatography with Post-column Derivatization/Silicomolybdenum Yellow Detection", Analytical Sciences, **34**, 477-481, 2018
12) N. Saito, Y. Kitamaki, S. Otsuka, N. Yamanaka, et al., "Extended internal standard method for quantitative ^{1}H NMR assisted by chromatography (EIC) for analyte overlapping impurity on ^{1}H NMR spectra", Talanta, **184**, 484-490, 2018
13) K. Iida, H. Sakurai, "Counting Efficiency Evaluation of Optical Particle Counters in Micrometer Range by Using an Inkjet Aerosol Generator", Aerosol Science and Technology, **52**, 1156-1166, 2018
14) N. Aoki, T. Shimosaka, "Development of an Analytical System Based on a Magneto-pneumatic Oxygen Analyzer for Atmospheric Oxygen Determination", Analytical Sciences, **34**, 487-493, 2018
15) T. Watanabe, T. Sasaki, T. Yoshimura, et al., "Application and Validation of a Determination Method Using Post-column Reaction Gas Chromatography of Nitrogen-containing Organic Compounds", Analytical Sciences, **34**, 853-857, 2018
16) D. Asakawa, H. Takahashi, S. Iwamoto, K. Tanaka, "Fundamental Study of Hydrogen-Attachment-Induced Peptide Fragmentation Occurring in the Gas Phase and during Matrix-Assisted Laser Desorption/Ionization Process", Physical Chemistry Chemical Physics, **20**, 13057-13067, 2018
17) P. Xia, S. Ri, Q. Wang, H. Tsuda, "Nanometer-order thermal deformation measurement by a calibrated phase-shifting digital holography system", Optics Express, **26**, 12594-12604, 2018
18) Q. Wang, S. Ri, H. Tsuda, M. Koyama, "Optical full-field strain measurement method from wrapped sampling Moiré phase to minimize the influence of defects and its applications", Optics and Lasers in Engineering, **110**, 155-162, 2018
19) A. Yunoki, Y. Kawada, Y. Hino, "Measurement of the response-ratio of an ionization chamber filled with dry air to that filled with P-10 gas in the calibration of gas monitors", Applied Radiation and Isotopes, **134**, 325-328, 2018
20) T. Uchida, M. Yoshioka, R. Horiuchi, "Effect of dissolved oxygen level of water on ultrasonic power measured using calorimetry", Japanese Journal of Applied Physics, **57**, 07LC04, 2018

Upcoming event

Welcome to IMEKO 2021!

The XXIII IMEKO World Congress will be held from August 30 to September 3, 2021 in Yokohama, Japan.
For more information : **www.imeko2021.org**

**Edited and issued by NMIJ International Cooperation Office (NMIJ ICO),
National Metrology Institute of Japan (NMIJ),
National Institute of Advanced Industrial Science and Technology (AIST)**

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