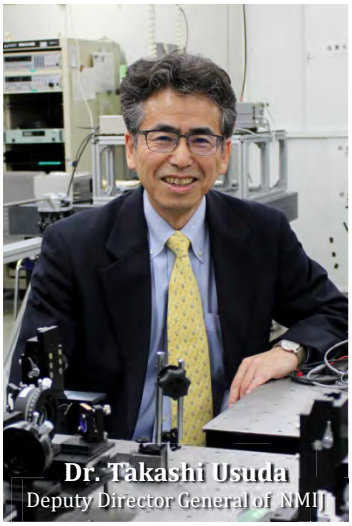
NMIJ Newsletter
No.3, May 2016
National Metrology Institute of Japan

Greetings from Deputy Director General of NMIJ

The NMIJ is the Japan's National Metrology Institute, and our mission is to develop, maintain and disseminate the measurement standards, as well as to support Japanese industries and to improve the quality of life as one of the departments of the National Institute of Advanced Industrial Science and Technology (AIST). The Research Promotion Division (RPD) is responsible for designing and coordinating plans and strategies to achieve this mission. The measurement standards are maintained by the global network as symbolized by CIPM-MRA. Supporting industry and improving the quality of life are also universalistic issues. The RPD is going to deal with the challenges in cooperation with you all.


Dr. Takashi Usuda
Deputy Director General of NMIJ

Activities and plans of the Research Promotion Division of NMIJ

As it is informed in the 1st and 2nd issues of the Newsletter, NMIJ was reorganized in April 2015, aiming at agile support to industry along with continuing supply of the measurement standards.
Research Promotion Division (RPD), the headquarters of NMIJ, plays a leading role in these activities. It consists of three offices with the following roles:

- Research Planning Office of NMIJ: planning researches and strategies, drawing up a budget

- NMIJ Public Relations Office: responsible for publication, needs survey, strengthening of relationships with stakeholders

- NMIJ International Cooperation Office: responsible for the Metre Convention, OIML treaty and promotion of bilateral and multilateral cooperation

Research Promotion Division promotes the following important tasks of NMIJ

- Development of the national metrology standards

Due to the rapid change of business environment, timely development of the measurement standards is required nowadays. Based on the user needs survey and up-dated new regulations, RPD designs a roadmap of the measurement standards development. Each of four research institutes develops measurement standards in accordance with the roadmap while they develop the next-generation measurement standards in step with redefinition of the International System of Units (SI).

- Calibration service and improvement of the national traceability system

Calibration service is one of the most important tasks of NMIJ. We provide information and advice, and improve calibration techniques and national traceability system so that wider users can access calibration services easily. In particular, we provide supports for small and medium-sized enterprises (SME). The development of reference and transfer standards is one of the other important tasks to promote the efficient calibration technologies.

- Innovation and technology transfer

Measurement technologies improve quality and reliability of industrial products and enhance industrial competitiveness. While NMIJ has contributed to industries through measurement instrument manufacturers and calibration laboratories, we started more direct commitment to the industries as well. The revenue from private sector for FY2015 increased by 150% compared with FY2014. The NMIJ provides engineering services directly by transferring measurement and analytical technologies to the industries to enhance their competitiveness. The NMIJ also supports industrial and international standardizations.

- Legal metrology and training

In order for the Measurement Law to be enforced adequately, NMIJ provides verification services and type approval test, and besides coordinates and carries out trainings for human resources for researchers and measurers.

NMIJ activities (Oct. 2015 – Mar. 2016)

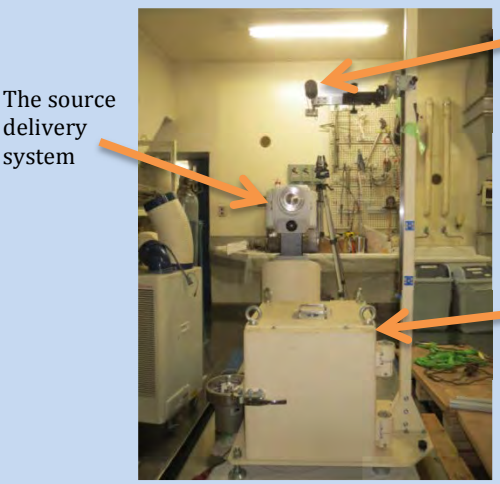
Research topics

The reference air-kerma rate for Ir-192 brachytherapy sources

Tadahiro Kurosawa and Norio Saito

The NMIJ has developed the national standard for the dose of Ir-192 brachytherapy sources that are used for cancer treatment. The calibration services for secondary standards in Japan have been started, and the traceability of dosemeters at hospitals will be established. The international comparison was carried out in April 2015 (BIPM-RI(I)-K8), and the value obtained by NMIJ was in good agreement with the other NMI's values within the uncertainties.

More detail in Japanese: *http://www.aist.go.jp/aist_j/press_release/pr2016/pr20160209/pr20160209.html*



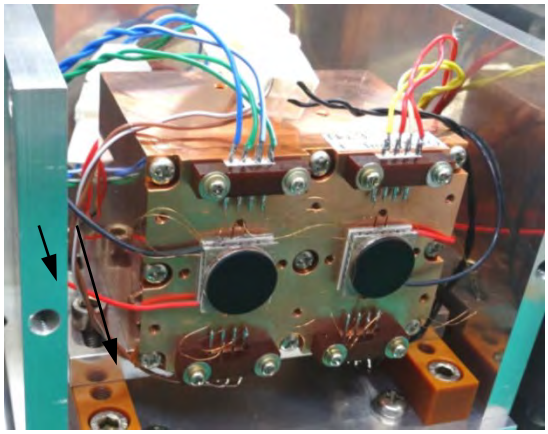
The experimental setup for the measurement of dose for the Ir-192 brachytherapy source

The Ir-192 source for cancer treatment (dummy source)

A highly-sensitive terahertz power sensor

Hitoshi Iida, Moto Kinoshita and Kuniaki Amemiya

Terahertz waves are electromagnetic waves ranging from roughly 100 GHz to 10 THz. New industrial applications using terahertz waves are expected for improving convenience and ensuring safety in a daily life: *e.g.*, security screening at airports, development of ultra-high speed wireless communications and novel functional materials for the next-generation, etc. To use terahertz waves for these applications, it is necessary to determine the transmitted terahertz power accurately. However, the technology to measure very small terahertz power quantitatively at room temperature has not been developed up to now.



Terahertz power sensor

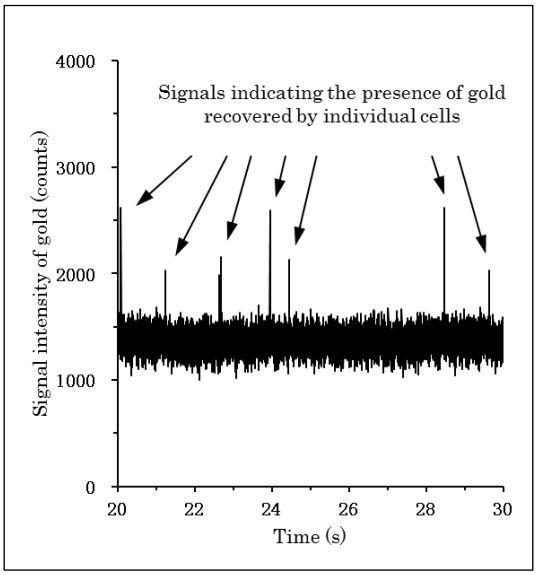
The NMIJ has developed a highly-sensitive terahertz power sensor working at room temperature. In this sensor, heat generated by absorbing the terahertz wave is converted into an electric signal by a thermoelectric device. The signal gives DC power that is equivalent to energy of the heat based on an isothermal temperature control technique. By measuring the DC power, the terahertz power is accurately and quantitatively determined. An absorber that efficiently absorbs the terahertz wave and has high thermal conductivity is used in a power detection unit of the sensor. Highly sensitive terahertz power measurement at several dozen nanowatts was achieved with sufficient thermal insulation around the sensor at room temperature. This quantitative measurement technique will be expected for the improvement of reliability and the advancement of various terahertz technologies in the future.

More detail in Japanese: *http://www.aist.go.jp/aist_j/press_release/pr2016/pr20160118/pr20160118.html*

The gold and palladium recovery technology from metal wastewater

Shin-ichi Miyashita, Shin-ichiro Fujii and Kazumi Inagaki

The NMIJ has contributed to establishing an eco-friendly and cost-effective method for recovering gold and palladium from metal wastewater by using a unicellular red alga *Galdieria sulphuraria*. Tsukuba University found that *G. sulphuraria* can accumulate gold and palladium under acidic conditions, indicating the potential applicability of the cells for recovering these precious metals from metal wastewater. The NMIJ verified that gold and palladium can be selectively and efficiently concentrated in the cells by using a highly sensitive and selective single-cell elemental analysis system. Generally, these precious metals are dissolved at low concentrations in metal wastewater and yet to be recovered due to high operation costs and technical problems. This method is an eco-friendly and cost-effective, and thus expected to be in practical use in the near future.



An example of analytical results of the gold-recovered *G. sulphuraria* cells from metal wastewater by using NMIJ originally-developed single-cell elemental analysis system.

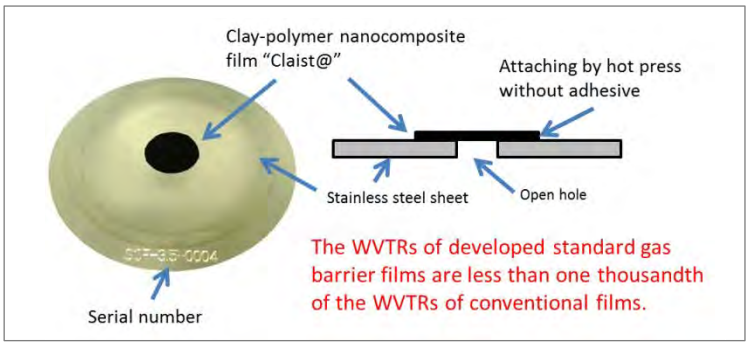
More detail in Japanese:
http://www.aist.go.jp/aist_j/press_release/pr2016/pr20160323/pr20160323.html

Standard gas barrier films to evaluate ultrahigh gas barrier

Hajime Yoshida and Takeo Ebina

Flexible organic electroluminescence devices (OLEDs), which are used as displays and lightings, have many advantages such as thin, light weight, being hardly broken, low energy consumption, and good compatibility with roll-to-roll process. However, when OLEDs are formed on a plastic film, the degradation of OLEDs due to water vapor and oxygen limits the lifetime of OLEDs. Ultrahigh gas barrier layers for water vapor and oxygen are coated on the plastic film to prevent the degradation of OLEDs. The water vapor transmission rate (WVTR) of the ultrahigh gas barrier layers are required to be 10^{-6} g m^{-2} d^{-1} level. Various WVTR measuring devices and methods have been proposed to measure such an extremely small WVTR. However, the reliability of their measurement values has not been ensured sufficiently because of the absence of standard gas barrier films (SGB films) with WVTR of 10^{-6} g m^{-2} d^{-1} level.

The Research Institute for Engineering Measurement of NMIJ has developed SGB films with WVTR of 10^{-6} g m^{-2} d^{-1} level by collaborating with the Research Institute for Chemical Process Technology, AIST. The SGB films have been fabricated by directly attaching clay-polymer nanocomposite film "Claist®", which is developed by the Research Institute for Chemical Process Technology, to stainless steel sheet with an open hole by hot pressing. The WVTR of SGB film is controlled by two factors; the WVTR of Claist®, which is controlled to be 2.0×10^{-3} g m^{-2} d^{-1} by adjusting processing parameters, and the area of the open hole. Three types of SGB films in the range of WVTR from 1.0×10^{-4} g m^{-2} d^{-1} to 3.1×10^{-6} g m^{-2} d^{-1} at the condition of 40 °C and 90 % R.H. were prepared by changing the inner diameter of the open hole from 20 mm to 3.5 mm. These values of WVTR are one thousand times less than those of conventional one. The WVTR of the developed SGB films was experimentally confirmed to accord with the design value.



The calibration of WVTR measuring devices by using these SGB films contributes to the reliable evaluation of ultrahigh barrier films for OLEDs, which contributes to improving the lifetime of OLEDs.

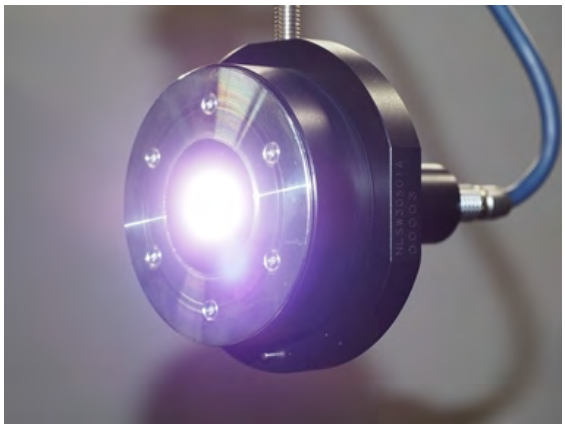
More detail in Japanese: *http://www.aist.go.jp/aist_j/press_release/pr2016/pr20160303/pr20160303.html*

The first standard LED covering the full visible light wavelength

Yuri Nakazawa, Kazuki Niwa and Kenji Godo

LED and OLED lighting, which are generally called solid-state lighting (SSL), become more common as the next generation lighting.

To evaluate total luminous flux and color of SSL with spectral measurement, NMIJ and Nichia Corporation have developed a new LED-based standard light source (standard LED) for using as a transfer standard for total spectral radiant flux (TSRF) scale in 2π geometry.

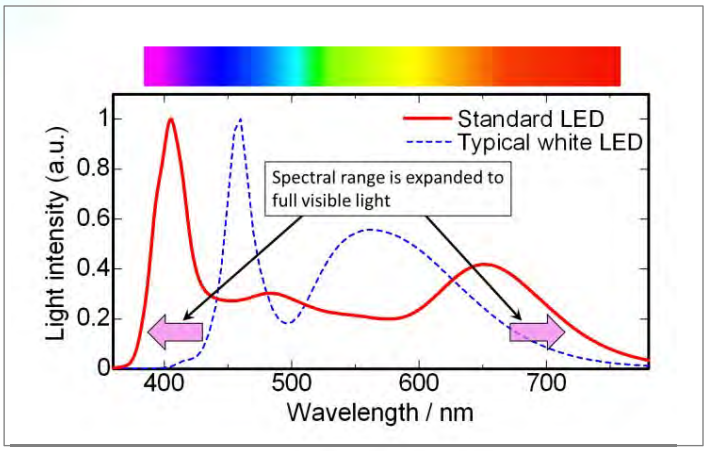


Photograph of the standard LED for 2π TSRF

Ideally, a spectral distribution of transfer standard for 2π TSRF calibration satisfies enough spectral power over full visible light. However, spectra of typical white LEDs do not cover the full visible light from 380 nm to 780 nm, and have some notches or peaks.

Therefore, the standard LED has improved on light intensity over the wavelength range of 380 nm to 780 nm by introducing multiple LED dies with different central wavelengths in combination with multiple fluorescent substances.

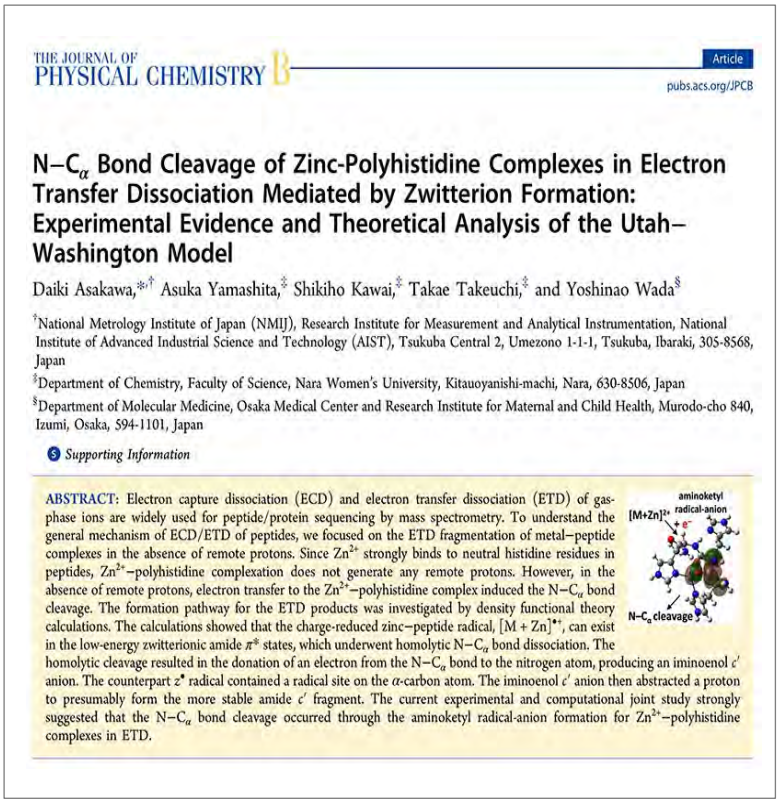
More detail:
http://www.aist.go.jp/aist_e/list/latest_research/2016/20160414/en20160414.html



Spectra of the developed standard LED and a typical white LED

Our figure makes the cover of "THE JOURNAL OF PHYSICAL CHEMISTRY B"!

Daiki Asakawa



THE JOURNAL OF PHYSICAL CHEMISTRY B — Article — pubs.acs.org/JPCB

N–C_α Bond Cleavage of Zinc-Polyhistidine Complexes in Electron Transfer Dissociation Mediated by Zwitterion Formation: Experimental Evidence and Theoretical Analysis of the Utah–Washington Model

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Supporting Information

ABSTRACT: Electron capture dissociation (ECD) and electron transfer dissociation (ETD) of gas-phase ions are widely used for peptide/protein sequencing by mass spectrometry. To understand the general mechanism of ECD/ETD of peptides, we focused on the ETD fragmentation of metal–peptide complexes in the absence of remote protons. Since Zn^{2+} strongly binds to neutral histidine residues in peptides, Zn^{2+}–polyhistidine complexation does not generate any remote protons. However, in the absence of remote protons, electron transfer to the Zn^{2+}–polyhistidine complex induced the N–C_α bond cleavage. The formation pathway for the ETD products was investigated by density functional theory calculations. The calculations showed that the charge-reduced zinc–peptide radical, $[M + Zn]^{\bullet+}$, can exist in the low-energy zwitterionic amide π^* states, which underwent homolytic N–C_α bond dissociation. The homolytic cleavage resulted in the donation of an electron from the N–C_α bond to the nitrogen atom, producing an iminoenol c' anion. The counterpart $z^\bullet$ radical contained a radical site on the α-carbon atom. The iminoenol c' anion then abstracted a proton to presumably form the more stable amide c' fragment. The current experimental and computational joint study strongly suggested that the N–C_α bond cleavage occurred through the aminoketyl radical-anion formation for Zn^{2+}–polyhistidine complexes in ETD.

I'm so proud that our figure makes a cover of the Journal of Physical Chemistry B. This is incredibly special for me and for co-authors, who have helped me and worked with me to achieve this research paper. I appreciate the great efforts of all my co-authors and the support of NMIJ colleagues.

Featured events

Sakura Science Plan 2015

The NMIJ and AIST organized a short course and welcomed 10 participants from Cambodia, Indonesia, Malaysia, Myanmar, Thailand and Vietnam from 14 to 21 February, 2016. The course was successfully held on the theme of “Promotion of the Quality Infrastructure (QI) implementation for the establishment of the ASEAN Economic Community (AEC)”, with participants visiting laboratories of NMIJ and a private company as well as a research institute. The NMIJ also presented lectures of basic subjects on weights and measures, traceability system and management system as well as the measurement uncertainties. In addition, participants attended the international symposium regarding SI redefinition organized by NMIJ held in Tokyo on 17 February, 2016.

By visiting the sites with advanced technologies and measuring instruments, the participants have obtained the knowledge and skills on quality infrastructure based on metrology. This course promoted the cooperative ties between participants and related companies/organizations in Japan. Furthermore, the future collaboration among participants in ASEAN region can be expected.

Group photo of the participants. This course was supported by “Sakura Exchange Plan in Science, FY2015” of the Japan Science and Technology Agent (JST).

Metrology Arena in Thailand 2016 in Bangkok

The NMIJ held the "Metrology Arena in Thailand (MAT2016)" in Bangkok on 18 to 19 January, 2016, aiming to strengthen research cooperation between AIST and local organizations in Thailand, as well as to support business expansion of Japanese companies into ASEAN region. The plenary session was opened by the remarks of Dr. Pichet Durongkaveroj, minister of the Ministry of Science and Technology of Thailand. Presentations on the themes of "Water and food safety" and “Manufacturing" were given with the keyword of "Quality Infrastructure." Lecturers included representatives from five companies and two related institutions from Japan. In the “Manufacturing session”, the panel discussion chaired by Dr. Takashi Usuda was also conducted. At the venue, 10 companies from Japan and Thailand opened the business exhibitions for information exchange and enhancement of cooperation-relationship with participants.

Participants in Metrology Arena in Thailand (MAT2016) in Bangkok

JICA training program "Social and Industrial Infrastructure in Legal Metrology in India"

from 24 January to 20 February, 2016

The International Cooperation Office of NMIJ has supported training programs in legal metrology under a framework of the Japan International Cooperation Agency (JICA) for more than 30 years. This training course has been conducted for one month under a two-years JICA program in FY2014-2015 in cooperation with the Japan Measuring Instruments Federation (JMIF). This program is aimed at providing opportunity to Indian participants to learn the metrological infrastructure in Japan, to identify current obstacles in their infrastructure and to find out a strategy to overcome the obstacles. A total of 26 participants attended this program in these two years from central/local governments of India which were responsible of implementation of the national metrological infrastructure.

At the AIST Tsukuba north site large flow meter calibration facility

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.


Guests from BIPM for the direct DC 10 V comparison

Name	Affiliation	Visiting Date	Visiting Topic
Dr. S. Chun, Mr. B. R. Yoon	KRISS, Korea	Oct. 19 - 22	Technical visit to liquid flow standards group
Dr. J. A. Dagata	NIST, USA	Oct. 19, Feb. 26 - 29, Mar. 01- 03	Interlaboratory comparison of particle size between NMIJ and NIST
Dr. Y. Tang	NIST, USA	Oct. 26 - 27	Programmable Josephson voltage standards technology
Dr. J. Wright	NIST, USA	Oct. 27	Technical visit to gas and liquid flow standards groups
Dr. D. Roy, Dr. A. R. H. Walker	NPL, UK NIST, USA	Oct. 27	Metrological ability of spectroscopic techniques
Dr. M. Abgrall	LNE-SYRTE, France	Nov. 18	Discussion for frequency standards and visit to radio-frequency standards
Ms. N. T. E. Darmayanti	RCM-LIPI, Indonesia	Nov. 23 - Dec. 01	Metrology hub in ASEAN
Dr. S. Solve, Dr. R. Chayramy	BIPM, France	Dec. 03 - 12	A direct DC 10 V comparison between NMIJ and BIPM programmable Josephson voltage standards
Mr. M. M. Mansor	NMIM, Malaysia	Dec. 07 - 18	Calibration technique of pressure balances at hydraulic high pressures
Ms. N. Alfiyati	RCM-LIPI, Indonesia	Nov. 23 - Dec. 26	Training on gauge block (GB) interferometer and research on double-ended interferometer for non-wringing GB calibration
Mr. H. Prawoko, Mr. R. S. Nasution	DoM, MTC, Indonesia	Dec. 12	Development of mutural collaboration
Mr. R. R. A. Samodro Mr. D. Nurcahyono	RCM-LIPI, Indonesia	Jan. 11 - 23	Research and development of pressure standards and inter-lab comparison methods for torque measuring devices in Asian region
Mr. D. Hermawanto	RCM-LIPI, Indonesia	Jan. 18 - 30	Realization of higher accuracy in primary calibration on free-filed sensitivities for laboratory standard microphones
Dr. K. Vacharanukul	NIMT, Thailand	Jan. 20 - Mar. 20	Training for EDM calibration
Dr. J. Beyer	PTB, Germany	Jan. 28	Joint research meeting between NMIJ and PTB
Dr. L. Ye	NIM, China	Jan. 28	Discussion for optical frequency standards
Dr. D. K. Aswal	NPLI, India	Feb. 04	Development of mutural collaboration
Dr. P. Richard	METAS, Switzerland	Feb. 17	Invited speech for the 12th NMIJ international metrology symposium
Mr. P. Siowattana	NIMT, Thailand	Feb. 17	Invited speech for the 12th NMIJ international metrology symposium
Ms. T. Mungmeechai	TISTR, Thailand	Feb. 15 - 26	Training for PCB analysis in environmental samples
Ms. D. Lee, Mr. J. Chang	KRISS, Korea	Feb. 24	Visit for sharing efforts for the new SI units promotion
Mr. A. Selamat	NMIM/SIRIM, Malaysia	Feb. 29 - Mar. 26	Study on precision measurement of RF attenuation for developing of Malaysian national standard of attenuation
Ms. J. Tanarom	NIMT, Thailand	Mar. 01 - 04	Discussion and meeting on research theme for doctoral program in Japan
Mr. P. Kulvanit, Mr. W. Chinchusak	DSS, Thailand	Mar. 06 - 11	Development of measurement techniques and systems about physical metrology of DSS and NMIJ

Peer review and international comparisons

The NMIJ sends the peer reviewers to NMIs on their requests (if available). In the recent half year, eight researchers were sent to four NMIs for CIPM-MRA on-site peer reviews. The NMIJ invited a peer reviewer in the frequency measurement area. Also, the NMIJ has participated in the following key and supplementary comparisons within this period.

NMIJ Participants	KCDB Code	Field	Title	Pilot Lab
Dr. T. Doi	APMP.L-S7	Length, step height	Comparison of step height measurements	NPLI
Dr. K. Ogushi, Dr. A. Nishino	APMP.M.T-S1 and other	Torque, 5 N·m to 2 kN·m	Comparison of torque standard machines	NMIJ
Dr. K. Amemiya	APMP.PR-S8	Optical fiber length, 3 km and 13 km	Comparison of optical fiber length	KRISS
Dr T. Tanaka	APMP.RI(I)-K3	Ionizing radiation	Comparison of air kerma for medium energy X rays	INER
Dr. K. Mizuno, Dr. A. Kurokawa	CCQM-K136	Surface analysis, porosity properties of nanoporous Al_2O_3	Measurement of porosity properties (specific adsorption, BET specific surface area, specific pore volume and pore diameter) of nanoporous Al_2O_3	UNIIM, BAM

Selected research reports

1) H. Abe, H. Kitano, N. Matsumoto, C. Takahashi, “Uncertainty analysis for trace-moisture standard realized using magnetic suspension balance/diffusion-tube humidity generator at NMIJ”, Metrologia, 2015, 52, 731-740

2) H. Takahashi, M. Maruyama, Y. Amagai, H. Yamamori, N. Kaneko, S. Kiryu, “Heat transfer analysis of a programmable Josephson voltage standard chip operated with a mechanical cooler”, Physica C, 2015, 518, 89-95

3) Y. Zhu, Y. Kitamaki, M. Kato, T. Kinumi, A. Hioki, K. Chiba, “Determination of sulfur in bio-samples by ICP-QMS/QMS with an ORC”, Journal of Analytical & Bioanalytical Techniques, 2015, 6, 282

4) N. Furuichi, Y. Terao, “Static pressure measurement error at a wall tap of a flow nozzle for a wide range of Reynolds number”, Flow Measurement and Instrumentation, 2015, 46, 103-111

5) Y. Shimada, H. Iida, M. Kinoshita, “Recent research trends of terahertz measurement standards”, IEEE Transactions on Terahertz Science and Technology, 2015, 5(6), 1166-1172

6) M. Tanabe, K. Amemiya, T. Numata, D. Fukuda, “Spectral supralinearity prediction of silicon photodiodes in the near-infrared range”, Applied Optics, 2015, 54(36), 10705-10710

7) S. Okubo, Y. D. Hsieh, H. Inaba, A. Onae, M. Hashimoto, T. Yasui, “Near-infrared broadband dual-frequency-comb spectroscopy with a resolution beyond the Fourier limit determined by the observation time window”, Optics Express, 2015, 23(26), 33184-33193

8) T. Yamada, C. Urano, M. Maezawa, “Demonstration of Johnson noise thermometry with all-superconducting quantum voltage noise source”, Applied Physics Letters, 2016, 108, 042605

9) W. Kokuyama, T. Watanabe, H. Nozato, A. Ota, “Angular velocity calibration system with a self-calibratable rotary encoder”, Measurement, 2016, 82, 246-253

10) A. Takamizawa, S. Yanagimachi, T. Ikegami, “External cavity diode laser with very-low frequency drift”, Applied Physics Express, 2016, 9, 32704

11) D. Asakawa, A. Yamashita, S. Kawai, T. Takeuchi, Y. Wada, “N–Cα bond cleavage of zinc-polyhistidine complexes in electron transfer dissociation mediated by zwitterion formation: experimental evidence and theoretical analysis of the Utah–Washington model”, Journal of Physical Chemistry B, 2016, 120 (5), 891–901

12) A. Yunoki, Y. Kawada, Y. Hino, “Improvements of the standardization of ^{134}Cs by the critical window setting for 605 keV photopeak”, Applied Radiation and Isotopes, 2016, 109, 374-377

Edited and issued by NMIJ International Cooperation Office (ICO)

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