NMIJ Newsletter
No.15, May 2022

Greetings from Director of CQMM

Dr. TAKETOSHI Naoyuki
Director of CQMM

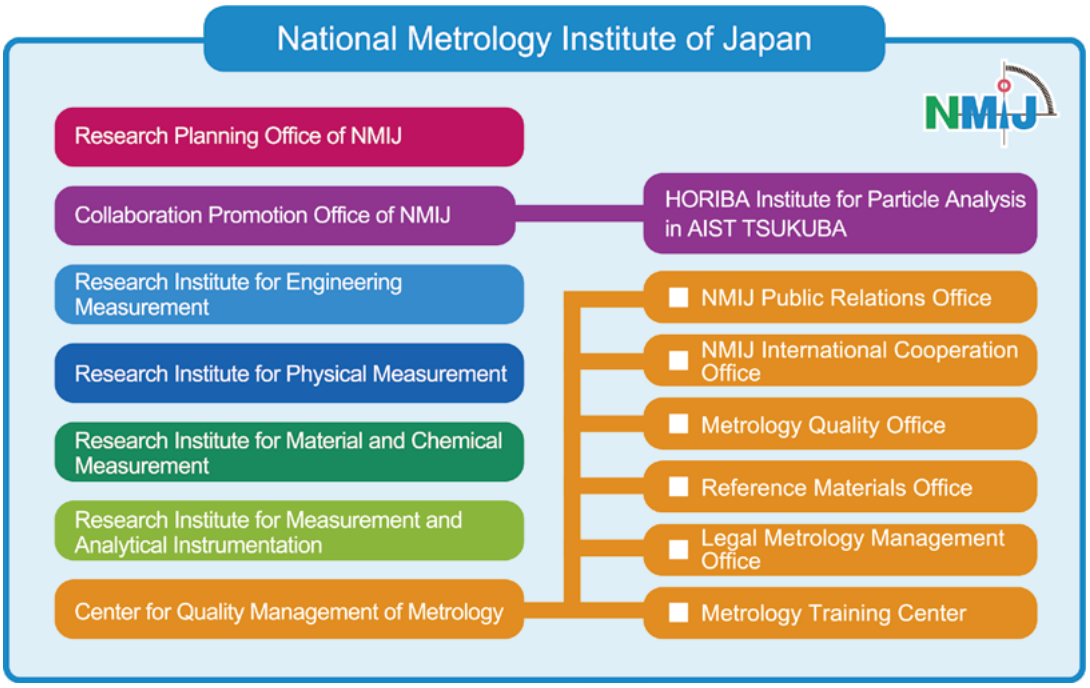
The Center for Quality Management of Metrology (CQMM), which is responsible for administrative support tasks in NMIJ, has an important role in disseminating measurement standards while ensuring proper implementation of measurement. The CQMM performs the following activities: public relations and consulting related to measurement standards and legal metrology; collaboration with international organizations such as National Metrology Institutes and other international legal metrology organizations; administrative support for issues pertaining to calibration, testing, and verification services; distribution of certified reference materials; cooperation with central and local governments to ensure the national metrology system; and technical training for metrology experts.

Although being impacted by the COVID-19, the CQMM is continuously conducting various activities, taking appropriate preventive measures. Online tools are actively used for disseminating information to foster human resources in the field of measurement standards and legal metrology and for holding events including seminar forums. Peer reviews/accreditation assessments are also conducted online to ensure international equivalence in measurement standards and legal metrology.

In the third term intellectual infrastructure development plan which started in 2021, focus is placed on the further enlightenment and dissemination of measurement standards. For a steady implementation of the plan, the CQMM will continue to provide a wide variety of services, collaborating with national and international metrology organizations.

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

Organization Chart of CQMM

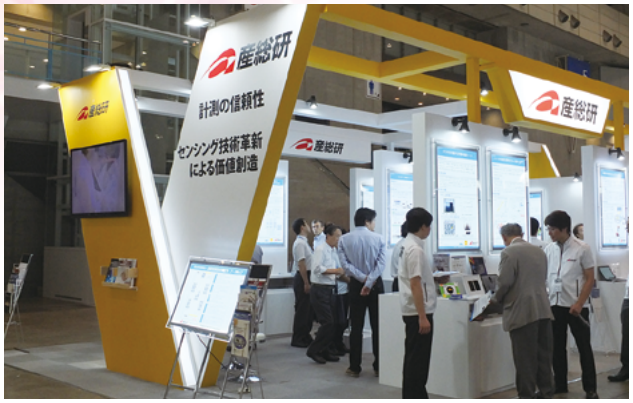


NMIJ's organizational structure has been renewed since 1st April 2022.

Introduction of CQMM

■ NMIJ Public Relations Office (NMIJ PRO)

NMIJ PRO is responsible for planning, coordination, public relations and general affairs of NMIJ. NMIJ PRO supports a variety of activities such as seminars, lectures, symposium, NMIJ measurement club and exhibitions, to promote the utilization of the measurement standards and to enlighten on the need for metrological traceability. In addition, NMIJ PRO disseminates the outcome of the activities related to metrology and measurement technologies via website and brochures.



Exhibition display

■ NMIJ International Cooperation Office (NMIJ ICO)

NMIJ ICO is in charge of international activities based on the Metre Convention and the OIML Convention. Such activities include the promotion of mutual recognition of measurement standards and OIML-CS certificates, the contribution to OIML technical work, and the conclusion of MOUs with overseas NMIs. NMIJ ICO also provides planning and support for research collaborations and training courses with international organizations. NMIJ Newsletter is issued twice a year as a public relations tool to disseminate information.

■ Metrology Quality Office (MQO)

MQO is the customer interface for the services (verification, inspection, type approval testing, calibration and issue of OIML-CS certificates) conducted by the four research institutes under NMIJ. MQO is also responsible for the operation of the management system covering these services in order to demonstrate NMIJ's mutual equivalence under the CIPM MRA and the OIML-CS. The management system is accredited by International Accreditation Japan (IAJapan), NITE.

■ Reference Materials Office (RMO)

RMO is responsible for the distribution of Certified Reference Materials (CRMs), which are produced under the NMIJ's management system to comply with ISO 17034 and ISO/IEC 17025. CRMs are characterized by a metrologically valid procedure for one or more specified properties, accompanied by a certificate that provides the value of the specific property, its associated uncertainty, and a statement of metrological traceability. The materials are intended to facilitate the calibration of analytical instruments and for use in the evaluation of analytical methods, ensuring their reliability in chemical measurements.

NMIJ Certified Reference Materials

■ Legal Metrology Management Office (LMMO)

LMMO coordinates activities in legal metrology conducted by NMIJ. LMMO cooperates and coordinates activities among METI (Ministry of Economy, Trade and Industry), local governments and NMIJ legal metrology groups regarding type approval, test, evaluation and technical consultation. LMMO cooperates with Metrology Training Center (MTC) through providing lectures, sending consultants, coordinating legal metrological seminars, etc.

■ Metrology Training Center (MTC)

MTC plans and manages various training courses for public servants engaged in legal metrology services and for those who want to become a nationally qualified certified measurer. MTC's current key challenge is a continuous strengthening of human resource development in the field of metrology under the COVID-19 pandemic. Online lectures are provided in some courses utilizing information and communication technology.

Lecture scene from a general measurement special training course.

Topics of CQMM

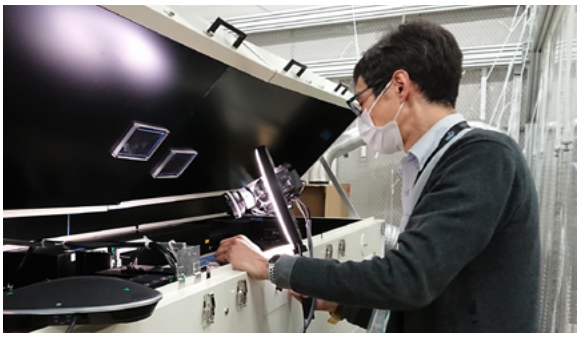
Underpinning the mutual recognitions through online peer reviews

YAMAZAWA Kazuaki

One of the important roles of NMIJ, AIST is to establish and maintain the signatory status under the CIPM MRA and the OIML-CS. For the CIPM MRA, APMP has been placing importance on onsite peer review upon approving the CMCs submitted by the NMI/DIs. APMP also mandates NMI/DIs to arrange visits by technical/quality peers that are approved by the relevant TC, which is unique and has long been a featuring method to ensure the competence of the NMI/DI within our region. It has also functioned as an event to deepen our mutual relationships. For the Scheme A under the OIML-CS, the Issuing Authority needs to demonstrate their competence under peer evaluations or accreditation assessments with Legal Metrology Experts (LMEs) being involved. In spite that these peer visits are deemed as important activities to underpin the mutual recognitions, due to the travelling restrictions caused by the COVID-19 pandemic, we need to seek for alternatives.

At NMIJ, we have carefully prepared and conducted 6 online peer reviews/accreditation assessments upon the approval of the relevant TCs, generous efforts of our peers and close work with our accreditation body. We have invested a huge amount of effort to enable our technical peers/accreditation assessors being deeply immersed in detail through sufficient camera work, audio settings and telecommunication as if they were visiting onsite. From our experience, we can mention that sufficient preparation and effective presentation for the online peer reviews could also reflect the competence of the NMI/DI. We will continue our improvement.

For year 2022, we further plan to conduct 4 peer reviews/assessments under the CIPM MRA and 1 assessment under the OIML-CS.



A snapshot during an online peer review of the calibration of line scale.

Activities of the Japan Metrology Forum

KUROIWA Takayoshi

The Japan Metrology Forum (JMF) was established in December 2000 with the support of the then Agency of Industrial Science and Technology, Ministry of International Trade and Industry. The purpose of the JMF's activities is to promote metrological traceability towards the realization of safe and secure life and the development of the industry. At present, 19 associations and institutions related to metrology are working together on the dissemination and enlightenment of measurement standards, focusing mainly on symposiums.

The 19th JMF Symposium (co-organized with NMIJ Metrology seminar) was held online on 25th February 2022 on the theme of "Measurement technology that contributes to ensuring the soundness of social infrastructure." Mr. OGURA Norihiko, CORE Institute of Technology Corporation, was invited to give a keynote speech. In his speech entitled "Measurement technologies required for infrastructure," Mr. OGURA shared the latest information on the monitoring and measurement technologies in the field of infrastructure onsite diagnostics. Some members of the JMF delivered talks on the measurement techniques related to future infrastructure such as distributed power supply and self-driving technology. The NMIJ introduced recent research activities of the Sustainable Infrastructure Research Laboratory (SiRL), which was newly established at the AIST.

The 17th JMF Symposium held in person in 2020.

The NMIJ will continue to contribute to the activities of the JMF with the aim of promoting the utilization of measurement standards.

Research Topics of Sustainable Infrastructure Research Laboratory

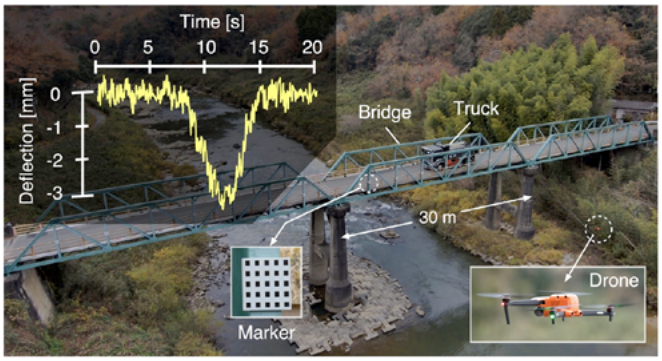
In order to achieve efficient maintenance and management of rapidly aging infrastructures, the Sustainable Infrastructure Research Laboratory is developing non-destructive inspection technologies that contribute to preventive maintenance and materials that contribute to extending the service life of structures.

Deflection measurement of bridges using drone aerial photography

RI Shien, YE Jiaxing, TOYAMA Nobuyuki

Social infrastructures are rapidly aging, and there are concerns about the increasing cost and effort required for maintenance and management. Deflection measurement is critical in evaluating the integrity of bridges as transportation infrastructure. The sampling moiré method was developed to accurately measure the displacement of structures by capturing the regular patterns (i.e., moiré markers) attached to the structures with a digital camera. The conventional approach is to fix a camera rigidly on a tripod or a fixed point. However, it is challenging to find a place to photograph bridges over the sea or mountains.

In recent years, drones mounted with cameras are rapidly becoming a go-to inspection technology for bridges and other transportation infrastructures. Therefore, we succeeded in developing a novel image stabilization technology and displacement measurement method that can measure the deflection of bridges by drone aerial photography. The effectiveness was verified by measuring the deflection of a 30-m-long truss bridge to detect a few millimeters displacement in the vertical direction. The newly developed measurement technology eliminates the restriction that the camera must be fixed and enables the measurement of the deflection of a more significant number of bridges.



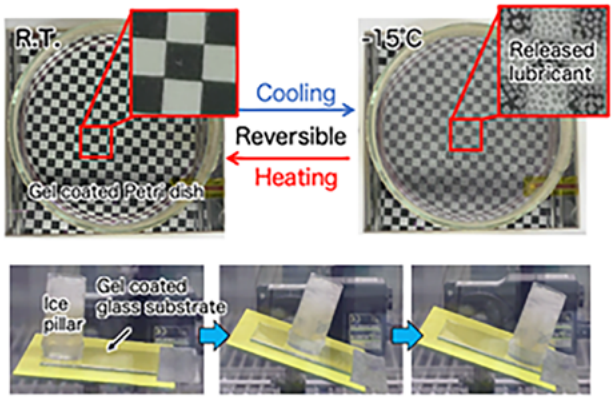
Deflection measurement of bridges by a drone camera.

Toward social implementation of snow and ice prevention material using self-lubricating organogel

URATA Chihiro

Nearly half of the land in Japan is considered to be heavy snowfall area, and in these areas, snow and ice adhere to and accumulate on the infrastructures in winter, causing various problems. For example, although the use of LEDs has made signal lights more visible, energy efficient, and longer lasting, a new problem has been emerging: the signal light surface is now easily covered with snow. If surface materials with excellent snow and ice releasing ability can be applied to the surface of the signal lights, it is expected to ensure the visibility of LED signals without using electricity and/or human power. In the Sustainable Infrastructure Research Laboratory, we are working on the practical application of self-lubricating gels, inspired by the antifouling mechanism of slug using mucus, to realize snow and ice free surfaces.

Self-lubricating gels are composed of silicone resins impregnated with lubricating oil and the gels are transparent, making it suitable as a surface treatment for road signs and solar panels as well as signal lights. In addition, lubricant-releasing property of self-lubricating gels can be tuned by controlling the affinity between the silicone resin and the lubricant. For example, it is possible to design an organogel that reversibly releases lubricants with temperature change. Since the temperature-responsive organogel releases the lubricant only at low temperatures, it can suppress unnecessary release of lubricants at high temperatures, promising long-lasting ice-releasing property. The simulated ice pillar removal test showed that forces required to detach ice on the organogel surface were less than 0.1 kPa, which is much smaller (more than 2000 times) than that of uncoated surfaces, and the ice pillar made on the organogel surface slid only by tilting the sample setup. We believe that the implementation of self-lubricating gel in society can contribute to the realization of a safe and secure society in heavy snowfall areas.



Upper: The thermoresponsive oil-releasing ability of the organogel (coated on a petri-dish). Lower: Anti-icing property of the organogels.

Featured Topics

APMP Technical Activity Award

APMP TCAUV

HORIUCHI Ryuzo

The APMP Technical Committee for Acoustics, Ultrasound and Vibration (TCAUV) was established in 1999 to promote cooperation among member economies throughout inter-comparisons and other technical projects. In the field of AUV, establishment of reliable primary standards and the related precise measurement techniques contribute to the technical areas such as environmental monitoring, automotive industry, and medical application. So far, TCAUV has conducted key and supplementary comparisons and provided the technical evidence necessary for NMIs to publish CMCs in KCDB 2.0. CMC submission has been reviewed by the three TCAUV working groups to cover each field of AUV.

TCAUV has an annual meeting in conjunction with APMP General Assembly and discusses future work plan including proposal for new comparisons and projects. In the meeting, participating NMIs exchange information throughout their presentations on the technical activities. At present, four key comparisons and two technical projects are in progress. NIM proposed the TC Initiative project 2018 and conducted the workshop on high intensity focused ultrasound for ensuring the safety of patients. Currently, research comparison of ultrasonic transducers is ongoing. On the other hand, NMIJ proposed the inter-comparison of sound level meters for supporting the developing NMIs to improve their calibration capabilities. Circulation of DUT is in progress.

Personally, I am very honored to serve as TCAUV Chair for three years since APMP GA 2018 and receive an APMP Technical Activity Award at APMP GA 2021. I appreciate APMP members' support during my term. In particular, I would like to thank TCAUV members, including pilot NMIs of comparisons, overseers of TCI projects, and members of WGs on CMC review for their great efforts.

While the COVID-19 prevented us from having face-to-face meeting, online meeting can save time and cost, and allow more participants to join. I hope TCAUV achieves the sustainable development under the new normal. Best wishes to APMP.

Dr. USUDA Takashi (left) and Dr. HORIUCHI Ryuzo (right)

APMP TCQM

INAGAKI Kazumi

The APMP Technical Committee for Amount of Substance (TCQM) is responsible for ensuring the equivalence of national measurement standards for chemical and biological measurements, thereby contributing to the establishment of global comparability of such measurements. TCQM organizes international comparisons to ensure the equivalence of chemical measurement standards for the analyses of inorganics, organics, gas, and biochemicals as well as of the calibration services. TCQM also acts as a forum for the exchange of information on technical activities related to measurement standards for chemical measurements.

APMP has focus groups to discuss what activities should be done to deal with global social issues and demands. Among these, TCQM has recently been collaborating with the following groups: Food Safety, Clean Air & Climate Change, and Clean Water. TCQM is also actively involved in the joint working group of the Asia Pacific Accreditation Cooperation (APAC), providing reference values for proficiency tests.

I served as TCQM Chair for three years from 2019 to 2021. During my term, things didn't work out as we had expected due to COVID-19. For example, we experienced delay in schedule of international comparisons. TCQM, however, was able to move forward step by step with the support from TCQM members including pilot NMIs of comparisons.

Without the support from the members, I could not have received the APMP Technical Activity Award in 2021. Once again, I would like to thank TCQM members for their dedication, hoping that the COVID-19 pandemic will end shortly and that we all will be able to get together again in person with a smile.

Dr. USUDA Takashi (left) and Dr. INAGAKI Kazumi (right)

12th APMP NMI Directors' Workshop

MORIOKA Takehiro

Dr. MORIOKA Takehiro
APMP EC member

The APMP NMI Directors' Workshop is ordinarily held in conjunction with APMP General Assembly (GA) to provide NMI directors with an opportunity to share information and knowledge on a specific topic. The 12th Workshop entitled "Foster Asia-pacific metrology collaboration in a digital world" was held online on 23rd November 2021 to consider and discuss impacts of digital transformation (DX) on NMIs and to develop APMP's strategy. The workshop had three sessions including NMI directors' views, informative presentations from APMP's stakeholders, such as sister RMOs, and technical talks on DX. Dr. USUDA Takashi, Director General of NMIJ, delivered his talk summarizing the outcomes from a survey distributed among APMP NMIs in advance of a similar workshop organized by BIPM in February 2021. In the same session, APMP Chairperson from NIM, China, introduced DX activities in their quality infrastructure (QI) and referred to the DX impacts on it. Directors from KRISS, Korea, and NIMT, Thailand, reported their strategic approaches to DX in addition to the planned and ongoing projects in their economies. EURAMET and SIM, leading RMOs in DX, introduced their activities related to DX and drew participants' attention since such information was very important for APMP to initiate DX activities. Chair of the Asia Pacific Accreditation Cooperation, one of the QI Bodies, delivered their experiences and plans in terms of digitalization related to the laboratory accreditation. One of the important topics in the workshop was to discuss the preliminary work plan of the Focus Group on Digital Transformation in Metrology (DXFG) in advance of its approval at GA. The Chair-elect of DXFG presented his plans and approaches to DX activities in APMP, and affirmative responses were obtained from participants. The peak number of participants was 123. Throughout the workshop, deep discussions were made on each presentation and participants enjoyed the talks and discussions.

Ms. Tanarom (NIMT) obtained a Ph.D. through the "NMIJ's Studying Abroad Program"

Ms. Jutarat Tanarom, a metrologist at Electrical Metrology Department, National Institute of Metrology (Thailand) (NIMT) has received a Ph.D. in Engineering from the Graduate School of Informatics and Engineering, the University of Electro-Communications (UEC) in Japan through the NMIJ's Studying Abroad Program in December 2021.

In 2016, Ms. Tanarom participated in the "Briefing Session on Studying Abroad for NIMT Staff" hosted by NMIJ to share the information of collaboration between the University in Japan and NMIT.

With a scholarship from Thai government in collaboration with NMIJ, she was accepted as a research student in 2017 and was admitted to a Ph.D. course in 2018 in UEC. In December 2021, she obtained a Doctor of Engineering degree. She says she believes that technical collaboration between NMIJ and NIMT will be more fruitful and is looking forward to continuing the cooperation on quantum devices for the realization of SI Units between NMIJ and NIMT.

Here is the message from her supervisor, Professor SHIMADA Hiroshi, Graduate School of Informatics and Engineering, UEC.

Ms. Tanarom conducted multiple experimental basic researches, applying supercurrent in a superconducting single electron transistor to a practical circuit. When it is combined with conventional superconductive electronics, the small supercurrent's magnitude of transistor poses a serious obstacle. To overcome the obstacle, she studied the way to deal with the increase in supercurrent when transistors are connected in parallel and the changes in properties associated with it. In pursuit of adding new functions to a device using the transistor's supercurrent, she also devised a new principle of a phonon detector and confirmed its operation. The sensitivity of the detector was experimentally found to be approximately 1000 times as large as that of the detector using conventional superconducting tunnel junctions. I expect that the outcomes of her research will be utilized in the research related to heat currents in nanodevices in the future.

From left: Dr. USUDA Takashi (NMIJ), Dr. Jutarat Tanarom (NIMT), Professor SHIMADA Hiroshi (UEC), Dr. KANEKO Nobu-hisa (NMIJ), at UEC, December 2021

21st NMI Directors and Member State Representatives meeting was hosted by KRISS, NIM, and NMIJ successfully

AKOSHIMA Megumi

Dr. AKOSHIMA Megumi
co-organizer

Dr. YAMAZAWA Kazuaki
speaker

The 21st NMI Directors and Member State Representatives meeting was held online from 11:00 to 13:00 (UTC) on 20th and 21st October 2021. The meeting was hosted by KRISS, NIM and NMIJ.

https://www.bipm.org/en/committees/di/partners

It consisted of the following three sessions:

- Reporting from the CIPM, BIPM and State Representatives Working Group (SR-WG)
- SI redefinition, Now and Future
- COVID-19

In the COVID-19 session, the survey results on the impact of the pandemic on NMI activities introduced in the NMIJ Newsletter No.14 were reported. In addition, activities and experiences during the pandemic, such as online peer review, accreditation, and utilization of metrology for economic recovery, were introduced.

The Best Paper Award of IMEKO XXIII World Congress

Dr. KAWAMURA Yasuki and Dr. NAKANO Tohru of Thermometry Research Group in the Research Institute of Physical Measurement received the Best Paper Award of IMEKO XXIII World Congress (IMEKO2021). The research for which they received the award is the development of alternatives for replacing the triple point of mercury (−38.8344 °C) which is indispensable to realize the international temperature scale of 1990 below 0.01 °C. This study is based on the precise temperature control, precise temperature measurement and temperature standard that NMIJ has developed over years. This paper is published in Elsevier's Measurement : Sensors.

Dr. NAKANO Tohru (left) and Dr. KAWAMURA Yasuki (right)

Reference:
Y. Kawamura and T. Nakano, "Evaluation of the temperature scale of SPRT calibrated at the triple point of sulfur hexafluoride," Measurement: Sensors **18**, 100211, 2021, DOI:10.1016/j.measen.2021.100211

International Activity Data

The following numbers show international activities implemented by NMIJ from April to December 2021. Due to the coronavirus pandemic, all peer reviews during this period were conducted online.

International comparisons (piloted by NMIJ in FY2021) − 29

Dispatched peer reviewers − 13 Invited peer reviewers − 4

Selected Research Reports

1) T. Yoshida, Y. Tasaka, P. Fischer, Y. Murai, "Time-dependent viscoelastic characteristics of montmorillonite dispersion examined by ultrasonic spinning rheometry," Applied Clay Science **217**, 106395, 2022, DOI: 10.1016/j.clay.2021.106395
2) N. Takegawa, M. Ishibashi, A. Iwai, N. Furuichi, T. Morioka, "Verification of flow velocity measurements using micrometer-order thermometers," Scientific Reports **11**, 23778, 2021, DOI: 10.1038/s41598-021-02877-w
3) K. Fujita, K. Fujii, L. Zhang, Y. Azuma, S. Mizushima, N. Kuramoto, "Investigating stability of Si sphere surface layer in ambient-vacuum cyclic measurements using ellipsometry," IEEE Transactions on Instrumentation and Measurement **71**, 1001409, 2021, DOI: 10.1109/TIM.2021.3129229
4) Y. Tanaka, H. Tanaka, "Development of stepwise tolerances for efficient verification of automatic checkweigher," Precision Engineering **72**, 568–575, 2021, DOI: 10.1016/j.precisioneng.2021.06.010
5) Y. Okazaki, T. Oe, M. Kawamura, R. Yoshimi, S. Nakamura, S. Takada, M. Mogi, K. S. Takahashi, A. Tsukazaki, M. Kawasaki, Y. Tokura, N. Kaneko, "Quantum anomalous Hall effect with a permanent magnet defines a quantum resistance standard," Nature Physics **18**, 25–29, 2022, DOI: 10.1038/s41567-021-01424-8
6) K. Okawa, Y. Amagai, H. Fujiki, N. Kaneko, "Reverse heat flow with Peltier-induced thermoinductive effect," Communications Physics **4**, 267, 2021, DOI: 10.1038/s42005-021-00772-4
7) Y. Kato, K. Omori, A. Sanada, "D-Band Perfect Anomalous Reflectors for 6G Applications," IEEE Access **9**, 157512–157521, DOI: 10.1109/ACCESS.2021.3130058
8) T. Irimatsugawa, Y. Shimizu, S. Okubo, H. Inaba, "Cosine similarity for quantitatively evaluating the degree of change in an optical frequency comb spectra," Optics Express **29**, 35613–35622, 2021, DOI: 10.1364/OE.435679
9) S. Miyashita, T. Ogura, T. Kondo, S. Fujii, K. Inagaki, Y. Takahashi, A. Minoda, "Recovery of Au from dilute aqua regia solutions via adsorption on the lyophilized cells of a unicellular red alga *Galdieria sulphuraria*: A mechanism study," Journal of Hazardous Materials **425**, 127982, 2022, DOI: 10.1016/j.jhazmat.2021.127982
10) N. Hanari, T. Nakano, "Comparison of short-chain chlorinated paraffin concentrations and homolog profiles by interlaboratory trial using a candidate reference material," Chemosphere **291**, Part 2, 132783, 2022, DOI: 10.1016/j.chemosphere.2021.132783
11) Y. Zhu, A. Itoh, "Pseudo isotope dilution (PID) as an approach for correcting barium-related spectral interferences on the measurement of europium by inductively coupled plasma mass spectrometry (ICP-MS)," Analytica Chimica Acta **1180**, 338854, 2021, DOI: 10.1016/j.aca.2021.338854
12) H. Kato, A. Nakamura, M. Shimizu, "Effect of surfactant micelle size on the dispersibility of aqueous carbon black particle suspensions prepared by ultrasonication," Powder Technology **399**, 117206, 2022, DOI: 10.1016/j.powtec.2022.117206
13) D. Asakawa, H. Takahashi, S. Iwamoto, K. Tanaka, "Hot hydrogen atom irradiation of protonated/deprotonated peptide in an ion trap facilitates fragmentation through heated radical formation," Journal of the American Chemical Society **144**, 3020–3028, 2022, DOI: 10.1021/jacs.1c11081
14) Q. Wang, S. Ri, P. Xia, J. Ye, N. Toyama, "Point defect detection and strain mapping in Si single crystal by two-dimensional multiplication moiré method," Nanoscale **13**, 16900–16908, 2021, DOI: 10.1039/d1nr04054e
15) J. Ye, N. Toyama, "Automatic defect detection for ultrasonic wave propagation imaging method using spatio-temporal convolution neural networks," Structural health monitoring, First Published March 1, 2022 (online), DOI: 10.1177/14759217211073503
16) S. Ri, T. Yoshida, H. Tsuda, E. Sato, "Optical three-dimensional displacement measurement based on moiré methodology and its application to space structures," Optics and Lasers in Engineering **148**, 106752, 2022, DOI: 10.1016/j.optlaseng.2021.106752

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