NIM Newsletter

ISSUE 04
JUL. 2022

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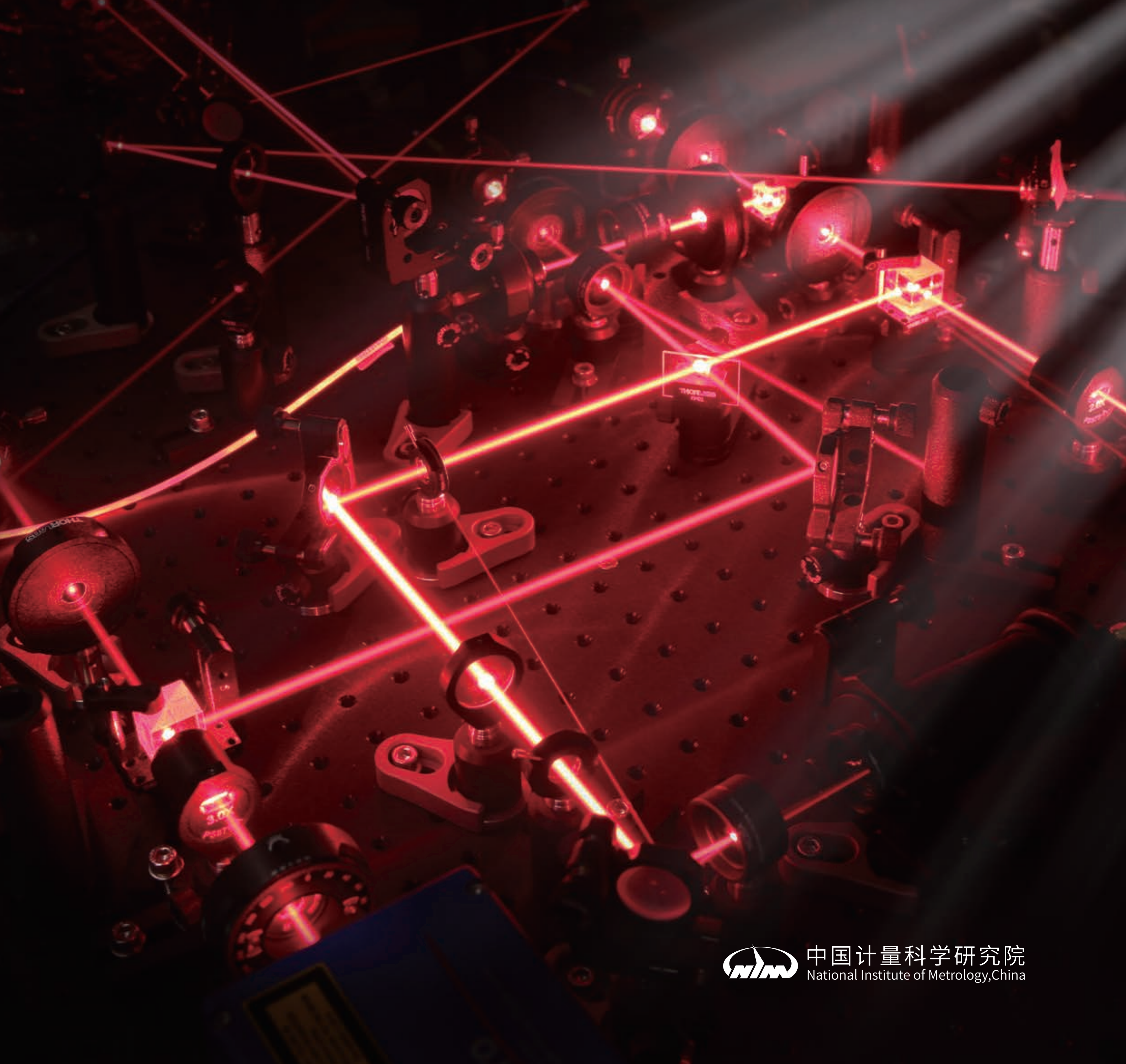

中国计量科学研究院
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Contents

NIM-Shijiazhuang Technology Transfer Base

In order to provide the SI traceable and internationally equivalent standard gases to meet the needs in key areas, such as the environment, medical and chemical industries, the National Institute of Metrology, China (NIM) in 2017 collaborated with the local government of Shijiazhuang, capital of Hebei Province located near Beijing, to establish the NIM-Shijiazhuang Technology Transfer Base, which started to operate in December 2020. The base was founded to translate laboratory achievements of gas standards in mass and commercial production and to deploy application technologies in environmental monitoring and protection.

Center for Environmental Metrology of NIM, China provides the technical foundation to the base regarding the development of SI traceable gas reference materials for many fields, such as environment, energy, petrochemical, safety warning, food, aerospace, medical, and the provision of accurate testing services for gas samples with low uncertainties. Up to now, NIM has developed 171 primary standard gases and 141 second standard gases, participated in nearly 60 international comparisons in the field of gas metrology and obtained 203 national measurement and calibration capabilities (CMC) under CIPM MRA. The gas analysis lab at NIM has been well equipped with precision gas analytical instruments, including long-optical-path Fourier infrared spectrometer (FTIR), cavity ring-down spectrometer (CRDS), ozone standard reference spectrometer (SRP), natural gas composition analysis solution, and gas chromatograph with pulsed discharge helium ionization detector (GC-PDHID). NIM also maintained close cooperation with NIST, NPL, KRISS, NMIJ and VSL in gas metrology.

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The NIM-Shijiazhuang base produces the gas reference materialsfor NOx, SO_2, CO, etc and provides metrological service to over 90% of some 1700 state-owned air quality monitoring stations in China that are under the responsibility of China National Environmental Monitoring Center. By now, it has provided thousands of bottles of SI traceable and accurate gas standardsin NO-SO_2-CO and VOC according to NIM technical specifications with a well-defined traceability for domestic verification organized by the China National Environmental Monitoring Center. In addition, a joint venture company was established between NIM-Shijiazhuang base and a local company to ensure the supply and service of gas reference materials. Covering the land of 2,000 square meters for production and testing sites and warehouses, the joint venture has more than 100 pieces of various gas reference materials preparation and testing equipment, with an estimated annual capacity of 50,000 gas reference materials units.

Fig. 1 Laboratory of gas metrology in Shijiazhuang Base

China's National Key Research and Development Program of National Quality Infrastructure 2.0

The concept of National Quality Infrastructure (NQI), proposed by the United Nations Industrial Development Organization (UNIDO) and the International Organization for Standardization (ISO) in 2006, consists mainly of metrology, standardization, accreditation, and conformity assessment. The NQI is one of the building blocks of the innovation system of China, underpinning its economic development. Metrology is one of the pillars of the NQI system. National Institute of Metrology (NIM), China undertakes the mission of constructing a modern advanced national measurement system. NIM has been playing a leading role in advancing the research and innovation in metrology in China.

China's Ministry of Science and Technology (MOST) initially launched the National Key Research and Development Program (NKP) of the "Research in and Application of Key Generic Technologies in the National Quality Infrastructure" (NQI 1.0) in 2016. Through the concept of integrated implementation, this program was designed to improve the research on the NQI's fundamental technologies to meet demands shared by various industries. In the NQI 1.0, 11 key tasks were completed with a total budget of 1.78 billion yuan, mainly focusing on metrology, standardization, inspection and testing, accreditation and certification, etc.

In the year 2021, the NKP of the "National Quality Infrastructure System" (NQI 2.0) was launched to conduct basic and frontier research in the NQI system and develop key techniques for NQI synergies and innovation. The program, which is demand-orientated and application-orientated, is expected to be completed in 2025.

The research fronts of the NQI 2.0 focus on the following:

1) Upgrading the technical standardization system by improving techniques in quantum metrology and methods for dissemination of quantity values.

2) Developing techniques for NQI synergies and innovation and for digital transformation in NQI in key sectors, such as the next-generation information technology, advanced manufacturing, life sciences and health, and green developments, and conducting research on core apparatus, with a view to developing capabilities to provide a systematic and comprehensive NQI service.

3) Advancing NQI integrated techniques that aim for typical applications and demonstrations in emerging industries and sectors for quality of life.

For NQI 2.0, NIM will continuously enhance its technical capabilities in research and applications, such as quantum sensing, chip-scale measurements, digital measurements, and metrology in life sciences. For instance, NIM will carry out basic and frontier research on quantum sensing and measurements in life sciences to establish more quantum-based primary standards; NIM will strive to make a breakthrough in key techniques and processes for chip-scale measurement standards, in order to achieve embedded and high precise devices to realize flattened traceability; NIM will integrate the artificial intelligence, big data, and quantum sensing technologies to facilitate the digital transformation of measurements, evaluation systems, and the quality infrastructure.

Optical Pressure Standard at NIM

Many industrial applications have been developed in the ranges of low vacuum (1×10^5 Pa to 1 Pa) and medium vacuum (1 Pa to $1\times10(^{-3})$ Pa), such as epitaxial growth of semiconductor films, laser etching of metals, chemical vapor deposition, and aerospace. In those applications, highly accurate, traceable measurements of pressure are vital. The present realization of the Pascal, the SI unit for pressure, by mercury manometer cannot keep up with the demand because of the international mercury ban. The optical pressure standard (OPS) is a mercury-free way to realize the pressure proposed by NIST. The OPS is based on fundamental physics, which links the Pascal to quantum calculations of Helium's refractive index, hence is also called quantum pressure standard. By measuring temperature and refractive index to high accuracy, one can determine the pressure and turn the device into a primary pressure standard based on the atomic properties of the gas.

NIM has developed the OPS recently by using nitrogen gas. The OPS consists of a dual Fabry-Perot (FP) cavity made from ultra-low expansion glass, a copper chamber housing the FP cavity, a temperature control system, and an optical system. Two tunable diode lasers at a wavelength of 633 nm were frequency locked to the measurement cavity and the reference cavity, and their frequencies were used to sense the pressure within the copper chamber. The performance of the FP cavity was investigated including the coefficient of thermal expansion and creeping effects. The temperature uniformity assessed for the copper chamber was within 1 mK. The so-called heat-island effect was elucidated and avoided for all measurements performed, and the influence of outgassing and leakage was considered. Non-linear and hysteresis behavior was observed for the deformation of the reference cavity. A direct comparison between the OPS and the NIM primary piston gauge showed no deviations greater than 10 parts per million for the pressures assessed in the range from 20 kPa to 100 kPa. The uncertainty of the OPS was evaluated to be $[(0.13\ \mathrm{Pa})^2+(23\times10^{-6}\ p)^2]^{0.5}$ (k=2).

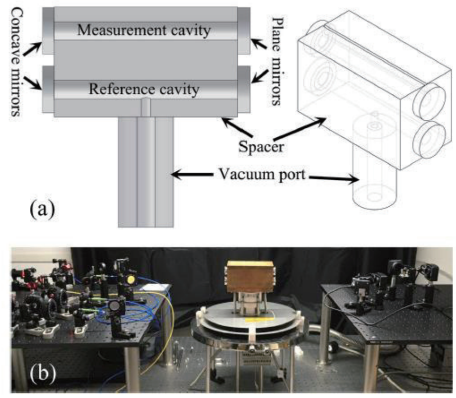

Fig. 2 (a)Structure of the dual FP cavity. (b) Overall view of the OPS, including the copper chamber (center), part of the temperature control system (covers removed) (center), and the optical set-up (left and right)

Pressure and vacuum standards based on the refractive index will significantly improve accuracy and offer zero-chain traceability for pressure measurements. This standard is not only promising for a primary realization of the Pascal in metrology institutes, but is very likely to become a commercial device to benefit science and industry applications, while being cheaper to maintain and having a larger pressure range and lower uncertainty. Increasing the precision of pressure measurements could bring not only practical advantages, but also could fundamentally advance science. Along with the participation of PTB, NMIJ, and some other NMIs in this research besides NIST and NIM, the world's metrology community will pave the way to a Quantum-Pascal era. When you can measure pressure more precisely, you might see the world more clearly.

Reference:

Yang, Y. et al. "Characterization of a vacuum pressure standard based on optical refractometry using nitrogen developed at NIM". Vacuum, 194 (2021): 110598.

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Boosting the Capture Efficiency of Carbon Dioxide by Microdroplet Reactions

The excessive emissions of carbon dioxide (CO_2) from the combustion of fossil fuels are one of the major contributors to global climate change. CO_2 capture and utilization is a promising approach to mitigating carbon emissions from point sources. As is known, the reactions between amines and CO_2, among the most commonly used and important carbon fixation reactions, are extremely critical to CO_2 capture and utilization. Therefore, methods that accelerate the reactions of amine and CO_2 are of great significance.

As reported in an article published on *Analytical Chemistry* (2021), NIM scientists, with colleagues from Zhejiang University, developed a highly efficient carbon fixation technique by using electrospray ionization (ESI) to conduct microdroplets-based reactions. Ammonium bicarbonate (NH_4HCO_3) was added to the bulk solution of the microdroplets to further promote the reac-tions. The presence of NH_4HCO_3 in ESI microdroplets significantly increased the conversion ratio (RC) of amines with CO_2. And it has been found that pure water, lower temperature of the mass spectrometer's entrance capillary, and lower flow rate of ESI all facilitate the increase of RC. More importantly, investigations revealed that the decomposition of NH_4HCO_3 into CO_2 within the microdroplets during ESI was crucial to the conversion of amines. The genera-tion of CO_2 resulted in the formation of microbubbles within the micro-droplets, remarkably increasing the total area of the liquid-gas interface which finally led to the rise of RC. ^{13}C labelled experiments confirmed that NH_4HCO_3 acted as an internal CO_2 source. And NH_4HCO_3 performed better than other bi-carbonates, such as sodium bicarbonate ($NaHCO_3$) and potassium bicarbonate ($KHCO_3$), in increasing RC.

The microdroplet reaction-based method was successfully developed for the highly efficient capture of CO_2. NH_4HCO_3 was used as an additive to significantly accelerate the microdroplet reactions of amines with CO_2. The obtained RC of amines was much higher than previous studies by a factor of about 50%. For the typical amine of DBPA, the RC reaches 93.7% under optimal conditions. The present study also implies that NH_4HCO_3 could be an excellent medium for CO_2 capture and utilization, contributing to future research on CO_2 conversion and further helping address the challenge of climate change.

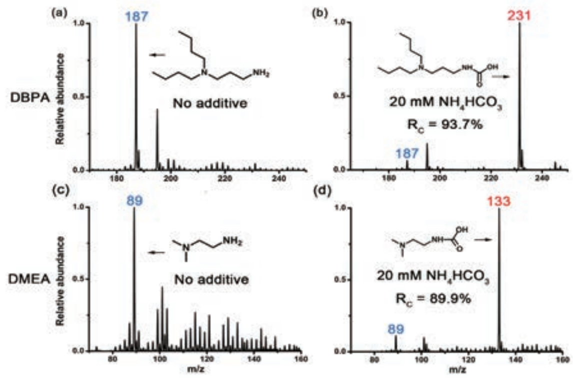

Fig. 3 Mass spectra of *N,N-dibutyl-1,3*-propanediamine (DBPA) and *N,N*-dimethylethylenediamine (DMEA) obtained with 0 and 20 mM NH_4HCO_3 in positive mode.

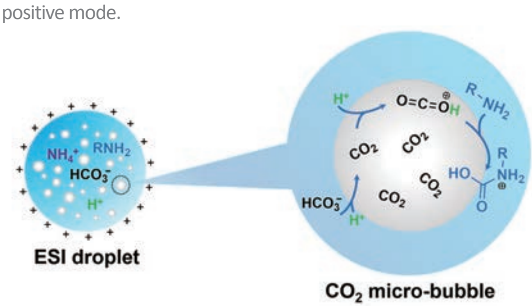

Fig. 4 The possible mechanism of microdroplet reactions of amines with CO_2 during ESI.

Reference:

Gong, Xiaoyun, et al. "Ammonium Bicarbonate Significantly Accelerates the Microdroplet Reactions of Amines with Carbon Dioxide." *Analytical Chemistry* 93 (2021): 15775–15784.

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NIM Develops Structural Certified Reference Material (CRM) at Atomic-Scale

Transmission electron microscope (TEM) and atomic force microscope (AFM) are critical tools for measuring atomic-scale structural parameters in various applications, such as metal alloys, integrated circuits, energy, environment, etc. The accuracy of values has a bearing on the reliability and safety of the samples/products. Developing a certified reference material (CRM) at the atomic scale is a challenging task, which needs to meet strict requirements of stability and homogeneity while pursuing high accuracy and traceability. Currently, reference materials for TEM and AFM calibration usually rely on consumable companies, instrument manufacturers, and self-made laboratory samples, yet their traceability is not asserted. These two types of equipment have played an important part in research institutes and industries, thus the demand for CRMs at the atomic scale with accuracy and traceability is increasing.

To meet the demands of quantity value dissemination and traceability of TEM at a two-dimensional atomic scale, National Institute of Metrology (NIM), China has developed an Au {111} interplanar spacing CRM (GBW13655[1]) based on the thin-film growth technique of sputtering deposition, with the value traceable to X-ray diffraction. A series of CRMs, including the Au {111} CRM, a previous-developed multi-layer film thickness CRM (GBW13955) and a technical guidance group standard "Calibration methods for transmission electron microscope", has built a complete TEM calibration system, which meets TEM calibration requirements at all size ranges. Meanwhile, NIM has developed a mono atomical step height CRM of $SrTiO_3$ (GBW(E)136709[2]) for AFM calibration, which indicated high stability and pollution resistance, also suitable for storage and use in atmospheric environments. The values of CRMs are traceable to X-ray diffraction. Taking advantage of the $SrTiO_3$ CRM and a national standard for nanoscale thickness measurement by AFM, NIM is able to provide atomic-scale quantity value dissemination and traceability service for AFM in scientific and industrial research areas.

The above two CRMs have jointly built a three-dimensional atomic-scale value standard system, which can meet the requirements of atomic-scale value dissemination and traceability of TEM and AFM. The two CRMs have greatly enriched the quantity value dissemination and traceability of structural dimension parameters in China's material measurement, filled the vacuum of CRM at atomic-scale under 1 nm, and were fully recognized by international peers. In the future, the two CRMs will be used to provide technical services for TEMs and AFMs in China, and serve the measurement and evaluation of characteristic parameters of samples and products in scientific research and industry.

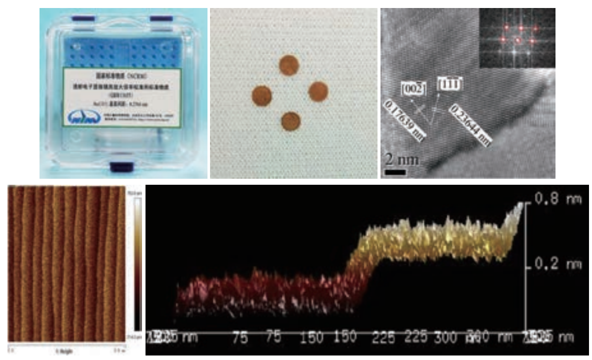

Fig. 5 Au {111} interplanar spacing CRM (GBW13655, top figure); a mono atomical step height CRM of $SrTiO_3$ (GBW(E)136709, bottom figure)

[1] CRM Code, as in the first class of National Certified Reference Materials
[2] CRM Code, as in the second class of National Certified Reference Materials

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In-Situ and Triaxial Calibration of Vibration Transducers

Vibration transducers are usually applied to health monitoring of high-value equipment and large facilities such as bridges, buildings and engineering machinery. In the actual environment, the state of mechanical motion is a complex three-dimensional vector vibration.However, the traditional uniaxial vibration calibration technique cannot be used to accurately determine the three-dimensional vector vibration. It can only be employed for reproducing the rectilinear motion in an ideal environment and for determining scalar parameters, such as the axis sensitivity, rather than the three-dimensional spatial sensitivity. On the one hand, the in-situ calibration of the vibration transducers used for health monitoring cannot be performed using the traditional vibration calibration technique. On the other hand, it is difficult for them to be regularly calibrated in laboratory. Therefore, the accuracy, effectiveness and reliability of monitoring data obtained by the transducers often cannot be ensured.

In order to meet the urgent industrial needs for triaxial and in-situ vibration calibration, NIM scientists has proposed new calibration methods, including real number field adaptive iterative control, time delay measurement and correction of nonlinear analog devices, and sensitivity vector calibration based on spatial motion orbit excitation. More importantly, we have developed key techniques, including 3D spatial motion orbit reproduction, triaxial laser primary vibration calibration, and 3D spatial sensitivity vector calibration. A triaxial vibration standard device based on the laser primary method has been developed to ensure accurate reproduction and measurement of three-dimensional vector vibration. The measurement ranges of three-dimensional acceleration reach (0.02 ~ 20) m/s^2, and the frequency ranges from 5.0 Hz ~ 1.6 kHz, with the measurement uncertainty of amplitude and phase being 0.5% and 0.5 ° (k=2). An in-situ calibration method of vibration transducers using environmental vibration or internal excitation provides vibration sources to in-situ calibration of vibration sensors. The three-dimensional spatial sensitivity vector matrix obtained by the triaxial vibration measurement technique is used to evaluate the measurement uncertainty and improve the in-situ calibration results.

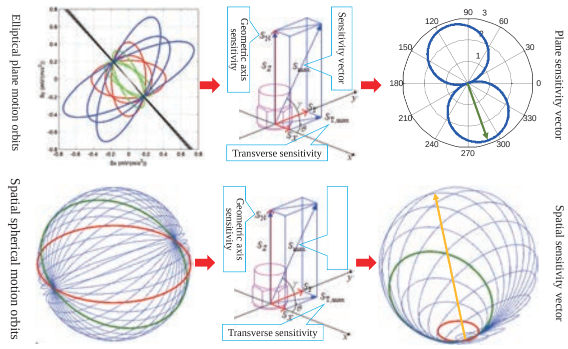

Fig. 6 sensitivity vector calibration by spatial motion orbit excitation

The research results have been applied to triaxial and in-situ calibration of vibration sensors in the fields of earthquake intensity rapid reporting and early warning, bridge construction health monitoring, etc; The sensitivity vector calibration of MEMS accelerometers and multi-axis micro vibration transducers were solved, which promoted the deployment and application of in-situ calibration vibration instruments.

The methods develpoped in this research have been incorporated into ISO 16063-1 ,and are to be incorporated into ISO 16063-31., and are chairing the amendment of the ISO 16063-31 currently. Moreover, NIM has developed the first international standard ISO 16063-45 for in-situ calibration of vibration sensors.

Reference:
Liu, Zhihua, et al. "Applying spatial orbit motion to accelerometer sensitivity measurement." *IEEE Sensors* Journal, 17.14 (2017): 4483-4491.
Yang, Ming, et al. "Bandpass-sampling-based heterodyne interferometer signal acquisition for vibration measurements in primary vibration calibration." *Applied optics*, 57.29 (2018): 8586-8592.

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Online Testing for Reliability Performance of Large-Scale Geometrical Parameters Instruments Used in Extremely Low Temperature Environment

Large-scale instruments for geometrical parameters are widely used in major projects, such as scientific facilities, railways, bridges, and dams. Poor performance of these instruments can lead to severe consequences. For example, under the force of landslides, ground fissures, or karst collapse, the deformation of lifeline projects, such as oil and gas pipelines, exceeds the allowable deviations, can lead to disasters and result in heavy casualties and economic losses. Therefore, monitoring structure deformation through instruments is an important means to ensure measurement quality and issue safety warnings. Since most of these instruments work in the open air under natural conditions, they should maintain normal operation in the open air under extreme temperatures to avoid false alarms or misinformation.

To test the reliability performance of large-scale geometrical parameters instruments in extremely low temperatures, NIM has established a Comprehensive National Testing Platform in Mohe, the northernmost county of China. The platform is able to provide length, astronomical azimuth and coordinate parameters testing through a 5040 m standard baseline, a high latitude (N53°) astronomical azimuth standard device, and a GNSS continuous reference station, etc. The extreme minimum temperature in Mohe was below -52.3 ℃ , and the days below -40 ℃ in a year can be more than 60 days. Making the most of the extremely low temperature, high latitude and excellent astronomical observation conditions in Mohe, taking the advantages of the 1.2 km standard baseline in Beijing, the 1.2 km outdoor air refractive index correction system, the Changping campus (N40°) astronomical azimuth standard device, and the GNSS continuous reference stations network, etc., NIM is able to provide comprehensive testing services for rangefinders, total stations, gyro theodolites, GNSS receivers and its derived measurement systems.

Fig. 7 NIM scientists carrying out online reliability testing at Mohe.

In the past two years, NIM Mohe and NIM Changping Comprehensive Testing Fields have served many representative instrument manufacturers and scientific research institutes. They will continue to provide online reliability testing services for various large-scale instruments used under extremely low temperatures, help troubleshoot the potential defects and dangers of the instrument used in extremely low temperature for long hours, and provide an objective basis of instrument quality reliability for the public. Through simultaneous observation with multiple GNSS continuous reference stations, the platforms are also applied to the research on the remote online calibration of GNSS receivers and other instruments, which promotes the sustainable development of the large-scale instrument industry.

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Metrology in Olympic Winter Games Beijing 2022

The Olympic Winter Games Beijing 2022 opened at China's National Stadium in February this year with the Olympic cauldron being lit once again since the Olympic Summer Games Beijing 2008. As we know, accurate measurement is necessary at all times and in all places during the Games. To help realize the commitment to organizing a green, inclusive, open and clean Games, NIM has made every effort, through reliable measurement techniques and services, to contribute to a wonderful Games.

Temperature Measurement for Curling Matches

The ice surface temperature, which directly affects the friction coefficient between curling and ice, should be strictly controlled to -6℃. When the bottom ice layer of the curling track is finished, it is necessary to put in place optical fiber temperature sensors before spraying the upper ice layer. These sensors are then connected to the distributed optical fiber temperature monitor which can continuously keep an eye on the temperature of the curling track in real time and provide reference data for venue maintenance. NIM calibrated the temperature monitor used in the "Water Cube", such as its temperature indication, indication error, minimum temperature sensing length, temperature positioning repeatability, etc.

Reference Materials for Physical Performance Monitoring

Fig. 8 Freeski cross athletes receiving blood lactic acid tests after exercise

Blood lactic acid, generated in the process of exercise, often leads to reduced athletic ability and great athletic fatigue. Portable biochemical analyzers, e.g. portable lactic acid analyzers, are usually employed to acquire athletes' physical performance information on site. However, there are still no SI-traceable reference materials and calibration techniques for these analyzers. NIM developed accurate measurement methods of lactic acid purity and blood lactic acid content through isotope dilution mass spectrometry and prepared reference materials accordingly. Moreover, *Guidance on Portable Lactic Acid Analyzer Calibration was published.*

Fig. 9 Reference Materials for lactic acid purity

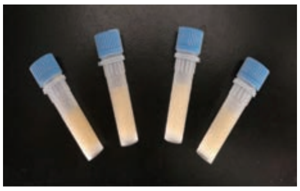

Fig. 10 Reference Materials for blood lactic acid content

Reference Materials for Foodborne Stimulant Testing

Fig. 11 Mixed solution reference materials for β-agonists

To address the urgent need to accurately detect foodborne stimulants during the Games, NIM developed 3 mixed solutions of β-receptor agonists, including 9 kinds of β-agonists, which were provided to doping control laboratories. Further, NIM developed the accurate measurement method of highly sensitive isotope dilution mass spectrometry for stimulants in such typical food matrices as pork and milk. Also, an inter-laboratory comparison was organized among 3 food security laboratories designated by the Games, in order to improve their testing capabilities and ensure the accuracy and reliability of the determination of β-agonists in food.

DIAL for Air Quality Monitoring

Fig. 12 DIAL in operation at China's National Stadium for air quality monitoring

"Beijing Blue", the most beautiful background color during the Games, has deeply impressed everyone, in which metrology has played an indispensable role. Together with China National Environmental Monitoring Centre, NIM applied the mobile differential absorption lidar (DIAL) for the first time to accurately measure and analyze the air quality of the key areas of the Games in the upwind and downwind direction. The field measurement lasted for 72 hours, and the results showed that the air quality of the competition area in Beijing was excellent, providing valuable data to ensure a sound environment for all participants.

Metrological Support for Novel Coronavirus Detection

Fig. 13 Mobile laboratory for novel coronavirus nucleic acid tests at the airport

A whole system for novel coronavirus nucleic acid tests, composed of a nucleic acid isolation machine, PCR amplifier, biosafety cabinet and mobile inspection cabin, calls for accurate calibration without which false-negative results and virus leakage would occur. And NIM provided the most accurate in-situ calibrations for the testing instruments located in China's National Olympic Sports Center, Beijing Capital International Airport, etc., which guaranteed efficient large-scale tests and accurate and reliable test results during the Games.

Microorganism Measurement for Food Safety

Fig. 14 CRMs of foodborne pathogens

As we know, foodborne pathogens are the main factor causing food safety-related incidents. However, the traditional culture-based methods in the national standards are time-consuming and labor-intensive for the detection of foodborne pathogens, which cannot timely respond to emergent food safety incidents. NIM has established a rapid and accurate technique by immunofluorescent flow cytometry, which has been utilized as a supplementary method for the Games to detect foodborne pathogens. In addition, the CRMs of foodborne pathogens, such as salmonella, staphylococcus aureus, and so on, have been applied in the food inspection agencies appointed by the Games to ensure the accuracy and reliability of the testing results.

Metrology is omnipresent in the Games whether you can perceive it or not, providing fundamental support involving where athletes play, how they physically feel, what they eat, how the air they breathe in is, and so on. In particular, those institutes that NIM cooperated with during the Games, e.g. National Environmental Monitoring Centre, food testing laboratories, etc., all gave credit for NIM's trustworthy measurement expertise delivered to the Games.

NIM's Efforts for Building up the Measurement Capabilities of NMIs in Mekong Countries

It is one of NIM’s major focuses for international cooperation on fit-for-purpose knowledge transfer for national metrology institutes (NMIs) in developing economies, with a view to improving their measurement capabilities in underpinning their commitment to Sustainable Development Goals (SDGs). By now, NIM's efforts for knowledge transfer have benefited approximately 20 economies in ASEAN and Africa as key areas. Major activities are comprised of mentoring on strategic planning, development of measurement standards, technical training and consultation, awareness raising for major stakeholders.

Lancang Mekong Cooperation (LMC) in metrology

One of the exemplary projects is the Lancang Mekong Cooperation (LMC) in metrology. It was designed to build up the metrological cooperation with Cambodia, Laos, Myanmar, Thailand and Vietnam to reinforce their Quality Infrastructure necessary to respond to demands from industries, trade, public health, sustainable development, etc.

Since the LMC in metrology was initiated in 2018 by NIM, multiple outcomes were scored in improving the technical capacities of partner NMIs’ in fields, such as mass and related quantities, dimensional, thermometry and electricity, through technical workshops and consultations, visiting scholar program, provision of measurement standards and calibration service, and awareness raising for stakeholders. More importantly, the six parties deliberated and signed the Joint Statement of Intent, a commitment to long-term collaboration in metrology and measurement standards.

Fig. 15 Signing ceremony of the Joint Statement of Intent

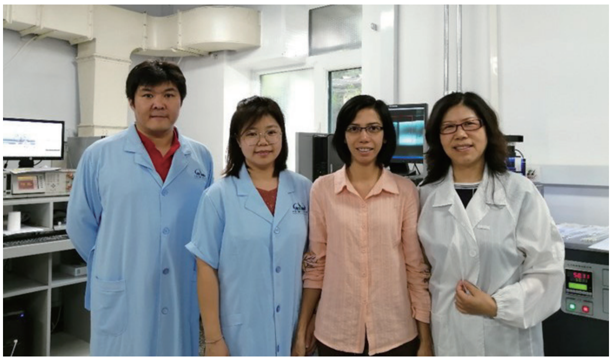

Fig. 16 Coaching on visiting scholars

Among all the capacity building efforts, Cambodia-China cooperation on electrical energy measurement was one of the cases that presented the tailored methodology for capacity building. A needs assessment was carried out to define the challenges facing the electrical industry in Cambodia, the current capacities of National Metrology Center of Cambodia (NMC), the gaps and the major stakeholders. NIM provided technical training for NMC metrologists in electricity, helped NMC work out an implementation plan for capacity building, coached on formulating verification regulations in measuring electricity meters, provided electrical measurement standards traceable to NIM and co-hosted the awareness raising events with NMC for major Cambodian stakeholders in electricity. Cambodia published its first verification regulation of electricity meters and NMC established the preliminary calibration capability for electricity meters, which marked the first and an important step in ensuring the confidence of measurement in electricity.

Fig. 17 Laboratory tour

Fig. 18 Training certificates to metrologists

For the year 2022, the LMC in metrology fosters cooperation in public health, environment and industry based on agreement among all partner NMIs. As the outbreak of the COVID-19 pandemic made physical activities impossible for the foreseeable

Fig. 19 LMC Symposium

term, NIM initiated an online training program under the LMC framework. Starting from this July, NIM will provide an online workshop on temperature and dimensional metrology, particularly on calibration of infrared thermometers key to accurate body temperature measurement for response to COVID-19. National Institute of Metrology of Thailand (NIMT)-NIM cooperation on $PM_{2.5}$/PM_{10} measurement is also progressing steadily regarding online coaching and consultation, which is open to all interested LMC NMIs. The Vice Director of NIM Dr Duan Yuning congratulated on the 24th Anniversary of NIMT on video. National Institute of Metrology of Myanmar (NIMM)-NIM cooperation project on key measurement standards in food and mechanical processing industries was launched to improve Myanmar's national measurement capabilities in temperature and length measurement.

The cooperative outcomes were highly received by all parties. Together with five PTB colleagues, Mr Fang Xiang, Director of NIM and Ms Gao Wei, previous Director of International Cooperation of NIM (now the Division Director of Mechanics and Acoustics), were conferred the Sahametrei Medal by Cambodian Royal Government as a token of friendship, for NIM's contribution to the metrological development in Cambodia.

UPCOMING EVENT

Therapeutics and Diagnostics: Measurements, Standards, Quality and Safety 2022

Introduction

The international workshop themed Therapeutics and Diagnostics: Measurements, Standards, Quality and Safety (TD-MSQS) was jointly initiated by the BIPM and NIM China, which is held every two years. Due to global travel restrictions caused by COVID-19, the 3rd workshop in 2020 ran on-site (Nanjing, China) and on-line, with a live broadcast in parallel, attracting over 300 on-site and 30,000 on-line audiences home and abroad.

In 2022, under the theme of "Measurements, Standards, Quality and Safety", the 4th TD-MSQS workshop will be co-organized by NIM China and the BIPM on August 19-21, 2022. The on-site conference will be set in Chengdu, China, with on-line access for international participants. Highlights of the meeting will include cutting-edge research and techniques in IVD measurements and standardization.

Event Date:
August 19-21, 2022

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Conference Website
http://www.tdmsqs.com

Plenary Theme

Therapeutics and Diagnostics: Research and Quality Assurance

Session Themes

A: Drug characterization and quality assurance
B: Research and quality control for in vitro diagnostics
C: Reference standards, regulation and metrology

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