

# APMP Member Report 2021

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*Center for Measurement Standards, Industrial Technology Research Institute,  
Chinese Taipei*

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*Please submit this report to [APMP-Secretariat@nim.ac.cn](mailto:APMP-Secretariat@nim.ac.cn) no later than 14 November 2021.*

## Section 1: General Management

### a. Structure of CMS/ITRI Staff and Contact Persons in APMP

No.	Name	Position in APMP GA & TC	Phone No.	E-mail address
1	<b>Dr. Tzeng-Yow Lin</b> General Director	GA Delegate	886-3- 5732143	Tzeng-Yow.Lin@ itri.org.tw
2	<b>Dr. Wei-En Fu</b> Director, Measurement Standards and Precision Instrumentation Div.	EC Member	886-3- 5732220	WeienFu@itri.org.tw
2	<b>Dr. Sheng-Jui Chen</b> Manager, Mechanics & Medical Metrology Research Lab.	Chair of TCM	886-3- 5732912	SJ.Chen@itri.org.tw

3	<b>Dr. Tsung-Hsien Tu</b> Manager, Dynamic Measurement and Engineering Application Lab.	Contact person of TCAUV	886-3-5743791	thtu@itri.org.tw
4	<b>Dr. Shih-Fang Chen</b> Manager, Electrical & Electromagnetic and Communication Measurement Lab.	Contact person of TCEM	886-3-5732109	csf0317@itri.org.tw
5	<b>Mr. Chun-Lin Chiang</b> Manager, Flow & Green Energy Metrology Lab.	Contact person of TCFE	886-3-5741211	C.L.Chiang@itri.org.tw
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8	<b>Dr. Yi-Chen Chuang</b> Researcher, Optoelectronic Measurement and Sensing Technology Lab.	Contact person of TCPR	886-3-5743834	ycchuang@itri.org.tw
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10	<b>Ms. Pin-Hao Wang</b> Manager, Quality Engineering Dept.	Contact person of TCQS	886-3- 5743710	Pin-Hao@itri.org.tw
11	<b>Dr. Chien-Chih Yeh</b> Researcher, Dynamic Measurement and Engineering Application Lab.	Contact person of TCT	886-3- 5743769	itriA20169@itri.org.tw
12	<b>Dr. Jen-Chieh Wang</b> Manager, Industrial Strategy Execution Department, Planning & Promotion Div.	Contact person of DEC	886-3- 5743830	DuskJCWang@itri.org.t w

**b. Cooperation / Connections with Other Parties of the National / Territorial Technical Infrastructure**

1. To respond the “Measurement for Health” as the theme of 2021 World Metrology Day, a video entitled “Precise Measurement Guarding Health” was made to address the issues of “COVID-19 epidemic prevention” and “health”. It is aimed to expand the public awareness of metrology’s importance to health issues, and to demonstrate the outcomes of developing health-related measurement technologies, and to express the respect to all measurement institutes and relevant staff.  
Leading by the encouraging speech from Dr. Wynand Louw, President of CIPM, the video introduces several metrology technologies for epidemic prevention and health, including the portable clinical thermometer calibrator, measurement technologies for the pressure and flow of ventilator, the measurement system of key parameters of ultraviolet sterilization products, and the precise dose ionizing radiation.
2. Dr. Tzeng-Yow Lin, General Director of CMS/ITRI, attended 21st meeting of NMI Directors and Member State Representatives during 21 - 22 October 2021.
3. Dr. Sheng-Jui Chen, also the APMP TCM Chair, attended the 18th meeting of the CCM and related meetings during 17 - 21 May 2021. CMS/ITRI has become the observer of CCM this year.
4. Dr. Tsung-Hsien Tu and Mr. Jiun-Kai Chen joined 13th meeting of the CCAUV as observers during 16 – 18 November 2021.

**c. Cooperation / Training & Workshop**

1. To facilitate the development of semiconductor inspection and metrology, CMS/ITRI together with SEMI established "SEMI Inspection and Metrology Committee" in 2019. In 2020, two working groups, focusing on specific topics of purity and particle analysis for semiconductor raw materials (WG1) and advanced packaging inspection - warpage measurement on wafer or substrate (WG2), have been established accordingly. For 2021, the "Semiconductor Advanced Inspection and Metrology Forum" will be conducted in December to discuss the state-of-the-art technologies of semiconductor inspection and metrology. Keynote speakers from Morgan Stanley and representative companies of metrology tools are going to interact and create the future vision.
2. CMS/ITRI and CIE-Taiwan conducted the Conference of Advanced UV for Life on 29 June 2021. With the supporting from UL, YF Precision, PRO-PII Technology, and Rapitech Enterprise and Instrument Systems, the conference discussed UV applications for epidemic prevention and relevant measurement technologies. CMS/ITRI has built the smart optoelectronic product certification laboratory to assist manufacturers to meet the requirements of international standards.
3. In response to the trend of the development of lithography technology in semiconductor industry, CMS/ITRI has focused on developing extreme ultraviolet (EUV) optical radiation measurement technology. On 16 September, we held the 2021 EUV Light Source and Sensing Application Webinar and invited three experts who have been engaged in the development of EUV equipment components. The speakers included P.G. Huang, CEO of Brightest Photonics Co., Ltd., Dr. Ya-Chin King, Professor of Electrical Engineering Department/Institute of Electronics Engineering, National Tsing Hua University, and Dr. Yi-Chen Chuang, Researcher of CMS/ITRI. It is expected that the webinar would attract more attentions on EUV-related technologies and facilitate the exchange and cooperation among domestic industry, academia, and research in related technical activities

## Section 2: Technical Highlights

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### a. Developments of Measurement Technologies for Semiconductor Industry

In response to the needs of the semiconductor industry's calibration traceability, CMS/ITRI is focusing on developing vacuum spectroscopic measurement technology and extreme ultraviolet (EUV) light detector characteristic measurement technology as the foundation of optical measurement technology for lithography process to provide the standard for characterizing the light source used in advanced lithography process, and measurement traceability for radiation dose measuring instruments.

For advanced semiconductor pitch measurement, we are focusing on developing the Grazing Incidence Small Angle Scattering (GISAXS) and Reflectivity Small Angle Scattering (RSAXS) technologies, pitch range:  $20 \text{ nm} \leq \text{pitch} \leq 50 \text{ nm}$  and repeatability  $\leq 0.1 \text{ nm}$ ; and Nano-particle Analysis and Standard Technologies for measuring the contaminating particles in the fabrication process with a reduction in the detection limit of small particle ( $< 20 \text{ nm}$ ) concentration to  $10^6 \text{ cm}^{-3}$ , for solving the problem of the poor detection limit of current particle measurement technology used for electronic grade reagents, and provides traceability for measurement and calibration conducted in current advanced fabrication processes.

### b. Total Solution of Flow Calibration Systems in Flow Standard Laboratory

Flow measurement is widely used in water, gas and oil transactions, and industrial manufacturing makes use of a variety of flow meters. The accuracy of meters can be ensured through regular calibration using flow standard systems as required.

CMS/ITRI provides a solution for the establishment of a standard calibration system which combines flow system engineering, industrial-level intelligent monitoring, measurement traceability and quality assurance solutions with the latest international standards and industry regulations to help customers improving the accuracy of flow measurement, thereby increasing product reliability.

CMS/ITRI's customizable solution features core component development, experiment and process optimization, intelligent measurement control procedures, and integration of on-site and remote communication.



The Low Pressure Gas Flow Calibration System - Mercury-sealed Piston Prover

We have assisted more than 20 domestic laboratories to establish their flow standard systems. Furthermore, we have also assisted Tokyo Keiso Co. Ltd., to establish a high-pressure gas flow calibration system in the Yilan County, Taiwan.

### c. Track Geometry Measurement System

For both railway construction and operation maintenance, track geometry measurement is an essential maintenance task to secure the safety of railway transportation. Currently all the instruments for the track geometry measurements are imported. According to the maintenance requirements, the measurement instruments need to be shipped abroad regularly for calibrations and repairs. It is time consuming with high cost. Besides, the software does not always fit different needs, e.g. different deviation allowance and different report format.



Track Geometry Measurement System

Hence, to accurately measure track geometry effectively and economically for domestic railway companies, CMS/ITRI introduces the Track Geometry Measurement System (TGMS), which is the first railway measurement instrument ever developed domestically. It provides measurements of track gauge, longitudinal level, alignment, cross level and back Gauge. Main features of the system include (1) EN13848-4:2011 conformable, (2) traceable calibrations to the National Measurement Laboratory, (3) full domestic maintenance support, (4) customizable software, (5) real time measurement and abnormality alarming.

### d. Portable Wind Turbine Blade Inspection Device and Development of Wind Turbine Tower Monitoring Technology

CMS/ITRI has developed a "Portable Wind Turbine Blade Inspection Device" which provides a novel solution for real-time quick check for the wind turbine blades. The novel device uses the noise of wind turbine as the signal source for damage detecting, it greatly reduces the number of hanging works and maintenance cost and increases the frequency of the inspection from every six months to every two weeks. So that in-time repair on damages of wind blades helps to avoid catastrophic structural damage.



Portable Wind Turbine Blade Inspection Device

"Technology for Monitoring of Wind Turbine Tower" includes on-site measurement and simulation technology to understand the critical damage effects of the wind turbine structure. We found the change of the second-mode frequency of the wind turbine column has direct relation to the damage of the foundation. The technology can be a tool for monitoring of wind turbine infrastructure and supporting data for the evaluation of wind turbine replacement.

**e. PV Mobile Lab Technology**

To ensure the quality of the PV modules is highly recommended to perform the test in an accredited laboratory. To do that the modules should be packaged and sent to the laboratory facilities. This situation can cause breakage due to transportation, aside from serious logistic problems.

The PV Mobile Lab is designed to perform the following tests, such as visual inspection, peak power determination in STC, electrical insulation, IR thermography and electroluminescence imaging. The design of the mobile laboratory ensures the reliability of the results as if in a conventional laboratory. Its innovative design based on an expandable mechanism and oil-hydraulic stretch platform has allowed us to implement a solar simulator of tunnel type in a vehicle which its weight is less than 3,500 kg. The spectral mismatch, non-uniformity of irradiance and temporal instability of irradiance of the simulator remain within the parameters that define it as a class AAA simulator or better. The environmental conditions during the performance of the tests are controlled.



CMS/ITRI PV Mobile Lab

The new PV Mobile Lab provides on-site test in PV modules, with the same reliability of an accredited conventional laboratory in the PV plants. The main advantage is that the installation duration could be reduced of the modules be sent to and back from the stationary laboratory, production down-time due to modules disconnection is minimized, aside from eliminating any breakage risks due to transportation of the modules to the stationary laboratory.

**f. Re-authorized by US FDA as the Only 3P510k Review Organization in Asia**

A 510(k) is a premarket submission made to FDA to demonstrate that the to-be-marketed device is as safe and effective, that is, substantially equivalent to a legally marketed device. CMS/ITRI, acting as an authorized review organization under this program since 1998, has reviewed 510(k) submissions on behalf of the FDA in years, covering 11 main types of medical devices, such like sphygmomanometers, ear thermometers, ECG patches, heart rate monitors, medical gloves, contact lenses, catheters, surgical electrosurgical units, and biochemical analyzers. More, we have also strived to assist professionals in furthering their understanding via training courses, which introduce the 510(k) regulatory requirements and the submission process. The number of course takers has exceeded 3,000.

This year, CMS/ITRI, passing the assessment of U.S. FDA, is re-recognized as the only 3P510(k) Review Organization in Asia, the review items expanded to 114 devices. It helps the industry to save time and money in obtaining the medical device 510(k) pre-market permission in entering into the US market, and therefore enhances the industrial competitiveness.

**g. Legal metrology technology development**

In this year, CMS/ITRI worked with the government to build and modify technical regulations to meet the market demands and technical requirements of the legal controlled measuring instruments, including (1) Assessing the need and feasibility of implementing type approval for active electrical energy meters for use, and amending the draft for the "Technical regulation for type approval of active electrical energy meters". (2) Conducting research on the battery metering mechanism of electric scooter for the government to formulate relevant pricing of charging/replacement reference standard and technical regulation. (3) Building technical regulation for the initial and subsequent verification of gas-oil ratio detectors for the control and the management of instruments of oil and gas recovery facilities.

## Section 3: CIPM MRA Related Matters

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**a. International Comparison Activity**

Statics of intercomparisons CMS/ITRI has engaged in since 1996

Technical Committee	Field	Intercomparison Completed	Intercomparison in Progress
AUV	Acoustics, Ultrasound and Vibration	6	2
EM	Electricity/Magnetism/Microwave	14	2
L	Length	18	4
M	Mass/Force/Pressure/Vacuum	19	11
PR	Photometry and Radiometry	7	5
QM	Chemistry	9	0
T	Temperature/Humidity	7	9
Total		80	33

Four intercomparisons CMS/ITRI has engaged in 2021

Item	Transfer Standard
APMP.M.FF-K3	Ultrasonic Anemometer

CCM.FF-K5	Flow rates for nature gas at high pressure
CCL-K11	Iodine stabilized HeNe-lasers
APMP AUV-A-K5	Pressure sensitivity level and pressure sensitivity phase of laboratory standard microphone type LS1P

**b. Status of Quality Systems**

The quality management systems CMS/ITRI established conform to ISO/IEC 17025:2017 for calibration and ISO 17034:2016 for reference material production. In 2021, four conformity assessments have been conducted by the Taiwan Accreditation Foundation (TAF) to ensure the validity of accreditation certificates. One surveillance assessment was held in February in Dimension, Electricity, Magnetism, Photometry & Radiometry. Due to the location of a dimensional measurement system has been changed, an amendment assessment in Dimension was conducted in September. The reassessment in Acoustics & Vibration was also conducted in September.

Due to the influence of COVID-19, no international assessor could travel to CMS/ITRI for on-site peer reviewing. Local experts were invited by TAF to perform the reassessment instead, but the scope of each service, including calibration method, production procedure, measuring range, and CMC, is kept the same as last review. However, a remote amendment assessment in Acoustics & Vibration was conducted by two experts from NMIJ/Japan in October. Thus, the scope of the calibration items could be updated.

**c. CMC Submission**

The number of CMS/ITRI's CMCs record in the KCDB is 298 (up to September 2021), including 59 in L (Length), 51 in EM (Electricity and Magnetism), 47 in PR (Photometry and Radiometry), and 141 items in other fields.

# Section 4: Future plans

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Besides operation of metrology standards, CMS/ITRI will keep extending the measurement capacities through industrial developments:

## **Semiconductor**

Innovation of measurement technologies for incoming material analysis, critical dimension measurement (front end), and structure inspection (middle end).

## **Healthcare**

Development of testing and evaluation service to help manufacturers to comply with international standards.

## **Net Zero and Energy issues**

Metrology for carbon emissions and the new energy sources (hydrogen energy).

## **Smart Machinery**

Modern calibration tools to facilitate the growth of industries' manufacturing quality.

## **B5G/6G**

Novel measurement methods for capturing mm-wave electromagnetic signals.

## **Cybersecurity**

Framework to ensure security during metrology digital information exchanging.

## **Railway**

Customized equipment to measure railway parameters for traffic safety.