



Overview of the APMP TCMM activities

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Introduction



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Brief Introduction



APMP The Asia Pacific Metrology Programme

TCMM TCMM is a multidisciplinary committee with a focus on metrology and traceability for materials properties and measurements. Areas covered includes nanometrology, graphene, physico-chemical characterization of nano- and advanced materials, such as ultra-thin film thickness, tensile strength etc.



Activities under APMP / TCMM



Ad-hoc WGEMP
(Working Group on the Evaluation of Materials Properties)

Ad-hoc WGMM was raised to TCMM

ILC:

Supplementary Comparison on Nanoparticle Size published in the KCDB TCMM and TCL

VAMAS and APMP signed the MoU

2001

2002

2012

2018

2019

2020

2021

Renamed as ad-hoc WGMM

TCI project:

Influence of data analysis on the results of x-ray reflectivity measurements for ultra-thin film thickness of complex multilayers
Project Leader: Dr. Lingling Ren (NIM)

Pilot study:

ILC on Si {220} lattice spacing using TEM

Pilot study:

ILC on GO thickness using AFM

TCI project:

Traceable temperature calibration of Dynamic Mechanical Analysers.
Project Leader: Dr. Sam Gnaniyah (NPL);
Collaborative activity between VAMAS/TWA 43 and both TCMM and TCT of APMP

TCMM Work Plan:
in progress



Potential TWA-TC links



TWA	Title	APMP TCs
TWA 2	Surface Chemical Analysis	TCQM, TCMM , TCL
TWA 5	Polymer Composites	TCMM , TCT, TCQM
TWA 16	Superconducting Materials	To be identified
TWA 24	Performance Related Properties of Electroceramics	TCEM, TCMM
TWA 31	Creep, Crack and Fatigue Growth in Weldments	TCM
TWA 32	Modulus Measurements	TCM, TCMM
TWA 34	Nanoparticle populations	TCL, TCMM , TCQM
TWA 36	Printed, Flexible and Stretchable Electronics	TCEM, TCM
TWA 37	Quantitative Microstructural Analysis	TCQM, TCMM , TCL
TWA 39	Solid Sorbents	TCQM , TCMM
TWA 40	Synthetic Biomaterials	TCT, TCMM , TCL
TWA 41	Graphene and Related 2D Materials	TCMM , TCM, TCQM, TCL, TCEM
TWA 42	Raman Spectroscopy and Microscopy	TCQM, TCMM
TWA 43	Thermal Properties	TCMM , TCT, TCL
TWA 44	Self healing Materials	To be identified
TWA 45	Micro and nano plastics in the environment	To be identified



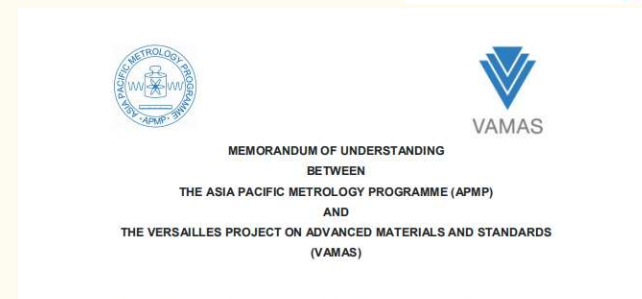
Memorandum of Understanding Between APMP and VAMAS



In June 2020, VAMAS and APMP signed the MoU

On the TCMM website, there is an additional depiction:

As the measurands for materials property measurements are often method-dependant, TCMM also engages with documentary standards organizations such as ISO, and with pre-normative standards development organizations such as VAMAS (Versailles project on Advanced Materials and Standards www.vamas.org).



traceability to SI units, reference material evaluation;
• co-development of effective validation properties supporting the advanced manufacturing information sharing and prioritization broadening of both parties' networks;
• activities aimed at increasing awareness associated challenges as a key future international metrology community and

Article III. Source of Funding and Personnel

Resourcing of specific activities is the responsibility of participants and that neither APMP nor VAMAS provide specific resources.

Article IV. Contact Points

The contact point for the cooperation on behalf of the Technical Committee of Materials Metrology while the sign-off point shall be the APMP Chair on behalf of VAMAS shall be the current Chair of their nominated representative.

Article V. Status of the Memorandum of Understanding

This Memorandum of Understanding states the parties to cooperate and is a non-binding agreement.

Article VI. Entry into Force and Termination

This Memorandum of Understanding shall enter into force for both parties and remain in force for five (5) years. The termination of this Memorandum of Understanding may be modified by the parties. The termination of this Memorandum of Understanding shall not affect the validity or duration of projects under the Memorandum of Understanding prior to such termination.



IN WITNESS WHEREOF, the parties have caused this Memorandum of Understanding to be executed in duplicate in English with each of the copies being equally authenticated by their duly authorized representatives.

FOR THE ASIA PACIFIC
METROLOGY PROGRAMME
(APMP)

Mr. FANG Xiang
APMP Chair

Date: 04 June 2020



FOR THE VERSAILLES
PROJECT ON ADVANCED
MATERIALS AND
STANDARDS (VAMAS)

Dr. Michael Faselka
Chair, VAMAS Steering
Committee

Date: 04 June 2020



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Activities



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The cooperation of TCMM with the international organizations



VAMAS leadership interview on 23 Mar. : APMP Chairman / NIM director Mr. Fang Xiang

Fernando Castro, NPL, VAMAS Chairman, Sam Gnaniah, NPL, Secretary; Michael Fasolka, NIST, VAMAS pre-Chairman; Nicholas Barbosa, NIST, VAMAS pre-Secretary, and Steve Freiman, NIST; Xiang Fang, NIM, APMP Chair, and Lingling Ren NIM, APMP TCMM Chair

- Understand the direction of priorities of the member regions and stakeholders.
- Recommend how VAMAS can better serve its members and stakeholders by more effective operations, new products and services and identify better impact metrics

Euramet EMN - APMP TCMM discussion on 25 March, 2022: Materials Metrology Gaps

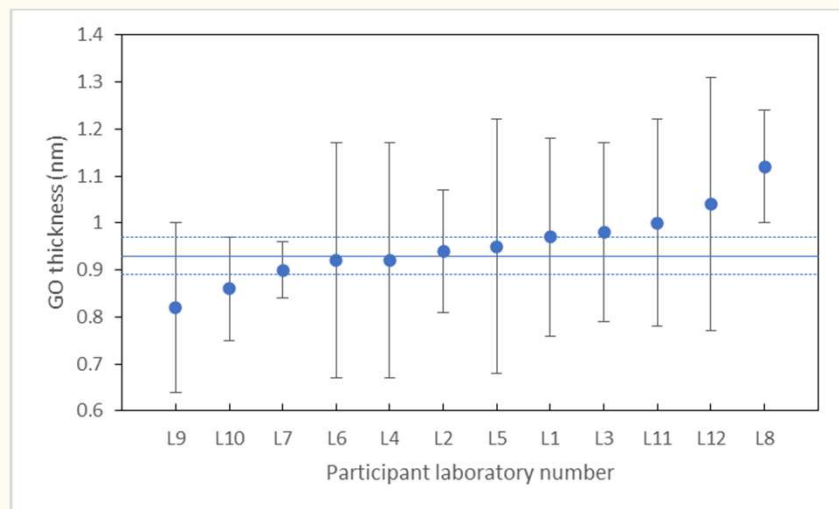
Lingling Ren, NIM from APMP TCMM & Fernando Castro, NPL from EUROMET EMN co-organized this discussion. Weien Fu & Fang-Hsin Lin, ITRI, Naoyuki Taketoshi, NMIJ, Victoria Colman, NMIA from APMP TCMM and Georges Favre, LNE from EUROMET EMN took participant in this workshop.

- Both TCMM and EMN AdvMan are developing strategic research agenda and road mapping activities to plan and inform their Materials Metrology activities.

Joint activities

APMP/TCMM-VAMAS/TWA41 joint ILC: *on graphene oxide thickness using AFM*

- 11 NMI and DoI attended this ILC.
- The manuscript is submitted to *Nanotechnology*.
- This result supports the development of an ISO standard on the measurement of graphene oxide flakes using SEM and AFM (ISO DTS 23879)

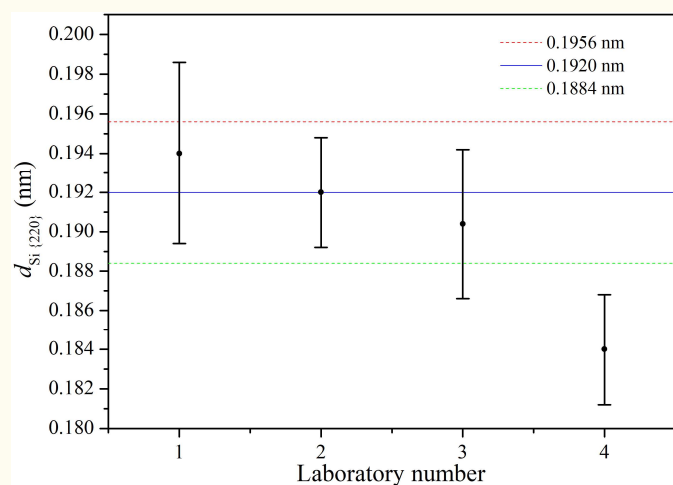


Joint activities

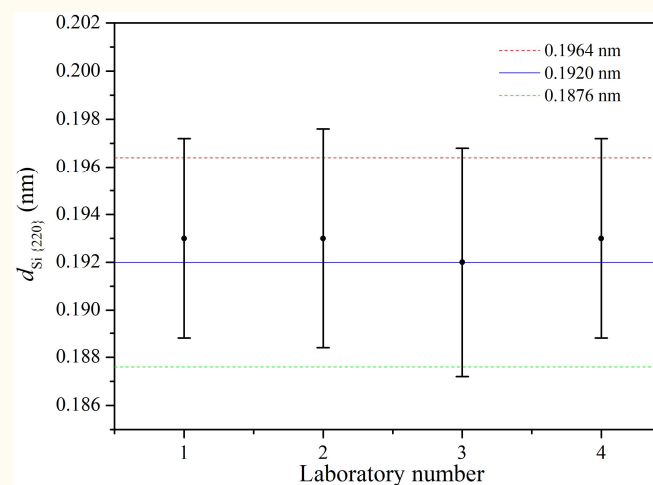
APMP/TCMM-VAMAS/TWA43 joint ILC: *on Si {220} lattice spacing using TEM*

Pilot Laboratory: NIM

Participants from NMIJ, NMIT, **NPL**, CNRC



The measured Si {220} lattice spacings of Sample C of four laboratories before calibration



The measured Si {220} lattice spacings of Sample C of four laboratories after calibration



A draft three-year work plan of TCMM



1. Dec. 2021 – Nov. 2022, Survey and fill the Tables to analysis what will be done in APMP/TCMM
2. Dec. 2022 – Nov. 2023,
 - a) Based on the above survey, summary the requirements of materials measurements in TCMM in the future. Moreover, draw the Road Map of materials measurement in TCMM. Hope to match the measurement foresights.
 - b) Complete the SC and pilot study projects.
3. Dec. 2023 – Nov. 2024,
 - a) Draft a guideline to join with TCX in APMP, or to link with CCXX in CIPM and TWA in VAMAS.
 - b) Draft the applying process guideline of a CMC from TCMM or TCMM-joint-TCX.



A draft three-year work plan of TCMM



Table1 the survey of common requirements for different types of materials

	Common parameters	instruments	Traceability Value range	Comparisons Project number	Measurement method ISO/IEC number	Method ILC VAMAS Project number	Remark
Particles	Particle size	TEM	1nm – 100nm ?	APMP/TCMM? CCL?			completed
		AFM	10nm – 1um ?				
		DLS	?				
		SEM	?	?			
		FFF	?	N			
						
Thin film	Thickness	AFM		TCMM-TCL SC			ongoing
		XRR					
		ellipsometer					
		Step height meter					
						
2-dimensional materials	Thickness	AFM				Project 2	Ongoing
		XRR					
		ellipsometer					
		TEM					
						



A draft three-year work plan of TCMM



Table2 the survey of specific requirements for different kinds of materials

		Specific parameters	instruments	Traceability Value range	Comparisons Project number	Measurement method ISO/IEC number	Method ILC VAMAS Project number	Remark
Particles	Gold	size	TEM		N			
			AFM					
			DLS					
		Plasmon resonance spectroscopy	UV spectrometer					
	Titanium oxide	Surface energy Raman enhance	Raman spectroscopy		?			
		size	TEM		?	?		
			SEM		?	N		
			DLS					
			FFF					
		Surface functional group content	SIMS				TWA2 project	completed
		Specific surface area	BET					
							
	fullerene	purity	Liquid chromatography					
			ICP-MS					
		Molecular structure	Raman spectroscopy				TWA39 project	completed
							
	Quantum dots	Quantum efficiency	Fluorescence spectrometer					
		Life time						
							



A draft three-year work plan of TCMM



2-dimensional materials	Graphene related 2-dimensional materials	Crystal structure	XRD					
		Molecular structure	Raman spectroscopy					
		Thickness/layer numbers	AFM TEM				TWA41 project4	COMPLETED
		Molecular structure	Raman spectroscopy					
		Ratio of carbon to oxygen	XPS				TWA41 project2	COMPLETED
		Purity	ICP-MS				TWA41 project3	ONGOING
			ICP-OAS					
			TGA				TWA41 project8	COMPLETED
		Specific surface area	BET					
		resistivity	Four-probes					
		Thermal conductivity						
							
							
							
	CVD Graphene	Molecular structure	Raman spectroscopy				TWA41 project1	Completed
		Thickness/layer numbers	AFM					
			TEM					
		Ratio of carbon to oxygen	XPS					
		Resistivity	Four-probes					
			Hall system					
		Thermal conductivity						
		Defect						
		Cleanliness						
		Transmittance						
							
							
	Others						



Thanks



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