European Metrology Network (EMN) for Advanced Manufacturing

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Georges Favre[1], Daniel O'Connor[2], Alessandro Balsamo[3], Alexander Evans[4], Fernando Castro[2], Anita Przyklenk[5] & Harald Bosse[5]

[1]*Laboratoire national de métrologie et d'essais (LNE), Paris, France* [2]*National Physical Laboratory (NPL), Teddington, United Kingdom*
[3]*Istituto Nazionale di Ricerca Metrologica (INRIM), Torino, Italy* [4]*Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany*
[5]*Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Germany*

georges.favre@lne.fr

INTRODUCTION

The European Metrology Network (EMN) for Advanced Manufacturing has been established in June 2021. Currently 11 EMNs focussing on different important topics of strategic importance for Europe exist and form an integral part of EURAMET, the European Association of National Metrology Institutes (NMI). EMNs are tasked to

- develop a **high-level coordination of the metrology community in Europe in a close dialogue with the respective stakeholders** (SH)
- develop a Strategic Research Agenda (SRA) within their thematic areas
- provide contributions to the European Partnership on Metrology research programme

Based on the analysis of **existing metrology infrastructures and capabilities of NMIs**, the **metrology research needs for advanced manufacturing** are identified in close cooperation with academic, governmental and industrial stakeholders. Here, we report on **advanced materials metrology needs** addressed in the EMN's preliminary SRA.

WHO WE ARE

EMN members

- 18 European NMI & Designated Institutes (DI) (Figure 1)

Partner Organisations

- European Technology Platform Manu*Future* [1]
- EFFRA Made in Europe Partnership [2]
- NanoFabNet [3]
- euspen [4]

Options for formal relationship between

- VAMAS [5]
- AMi2030 [6]

Stakeholder Council

- Currently 12 members from industry
- Representing EMN key industry sectors (Figure 2)

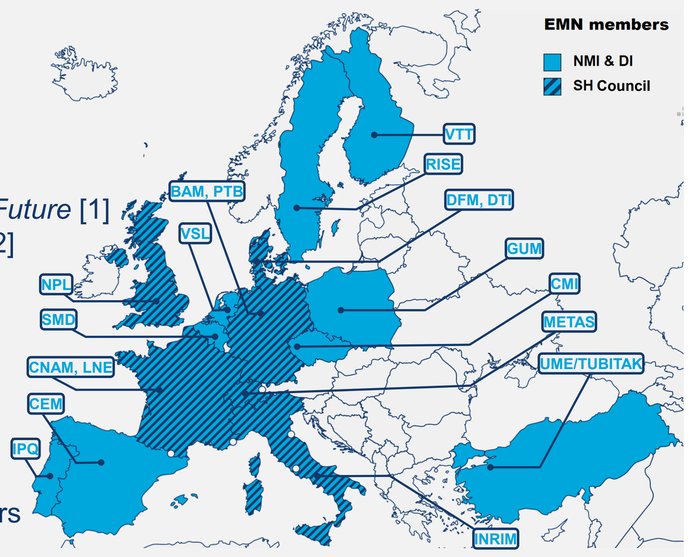


Figure 1: Map of EMN members.

STRATEGIC RESEARCH AGENDA

The EMN for Advanced Manufacturing is developing a SRA to identify priorities for research by Europe's NMIs and DIs and collaboration partners. Download: https://www.euramet.org/european-metrology-networks/advanced-manufacturing/strategic-research-agenda. The content of this preliminary versions may change due to ongoing consideration of stakeholder feedback. Updates are planned in summer on a yearly basis.

WHAT WE DO

- Goal: Consideration of metrology aspects for the entire manufacturing chain (Figure 3)
- Cyclic approach for activities (Figure 4)

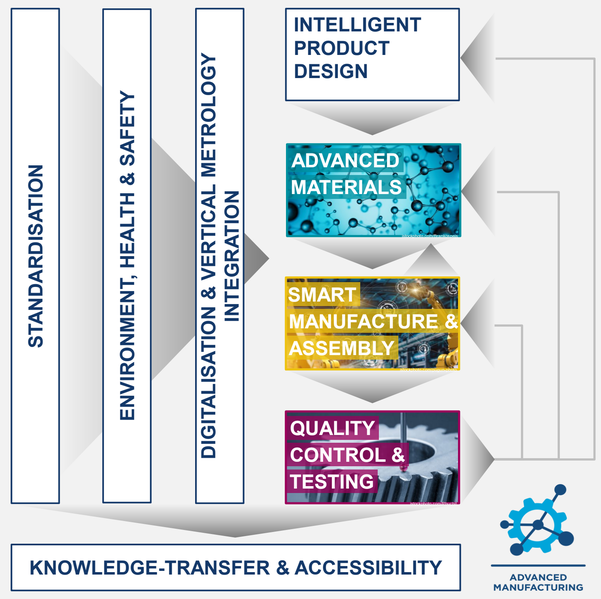
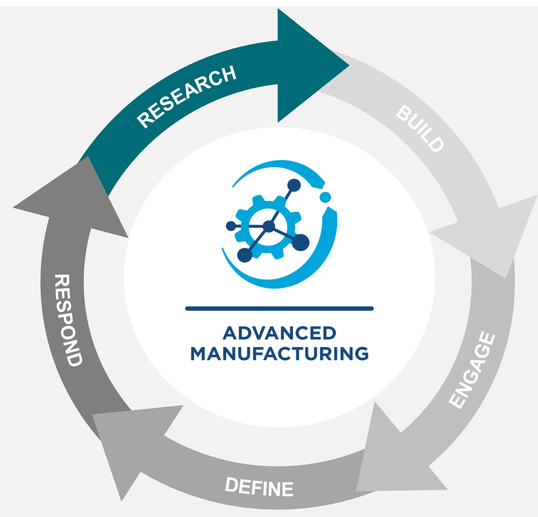


Figure 3: Cross-cutting topics of the manufacturing chain.



SH mapping & prioritisation according to EMN's KIS

SH engagement, needs & drivers

identify and define SH needs

respond to needs with SRA and roadmap

collaborative research projects on metrology topics with high impact on European industry

Figure 4: EMN activities general approach by EMN for Climate and Ocean Observation.

KEY INDUSTRY SECTORS

Ongoing stakeholder dialogue in all key industry sectors via frequently held **workshops** and **open consultation events** on special topics. An **online service desk** is in preparation and will be available soon.

Metrology equipment & service — Overarching key industry sector relevant for all the other key industry sectors

Machine tools & robotics	Digitalised & integrated manufacturing systems	Energy generation, transmission & storage	Advanced materials & processing
Nano- & microelectronics	Nano- & microtechnology	Optics & photonics	Land & sea-based mobility
Aerospace	Complex infrastructure & civil engineering	Life science technology	Defense & security

Figure 2: KIS of the EMN.

METROLOGY NEEDS IN ADVANCED MATERIALS

Advanced Materials addresses metrology and characterisation methods that are required to fully exploit the innovation potential of advanced materials, while ensuring safety and environmental compatibility. This encompasses the whole life cycle of manufactured products.

Cross-cutting topics:

- Working definition of Advanced Materials
- Harmonisation for increased comparability
- Reference materials
- Implementation of regulations, regulatory preparedness and safety aspects

Metrology for:

- Materials in complex environments
- Multi-techniques characterisation methods
- Process analytical techniques

NEEDS ALONG THE ADVANDED MATERIALS LIFE CYCLE: EXAMPLE OF ADDITIVE MANUFACTURING

HARMONISATION

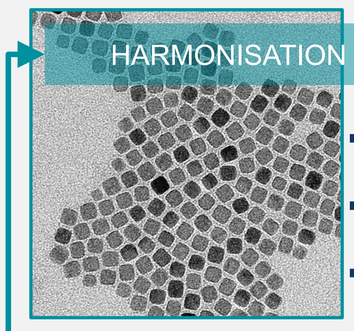


Figure 5: Reference material. Particles consist of iron oxide and have an edge length of ~8 nm.
Source: BAM

- Working Definition of Advanced Materials
- Development of relevant reference materials
- Implementation of regulations addressing safety aspects ...

POWDER PRODUCTION

Figure 6: Electrode Induction Melting Inert Gas Atomization Systems for the production of spherical metal powders.
Source: ADL

- Scalable metrology methods compatible with wide range of material specification
- Determination of link between process parameters & product quality …

QUALITY ASSURANCE I

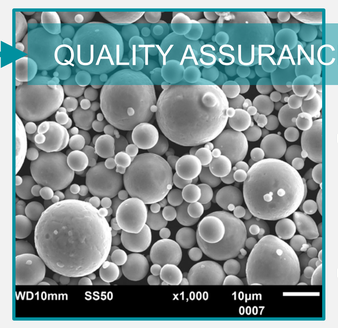


Figure 7: Scanning electron microscope image of m4p™ Superfine Metal Powders.
Source: metals4printing

- Advanced data analysis methods for hybrid metrology approaches
- High quality datasets to validate virtual testing and materials informatic approaches
- Measuring powder material distribution …

AM PRODUCT DESIGN

- Digital Product Pass
- Design tools using scaled mat. properties & uncertainties
- Design for circular economy ...

POWDER PROCESSING

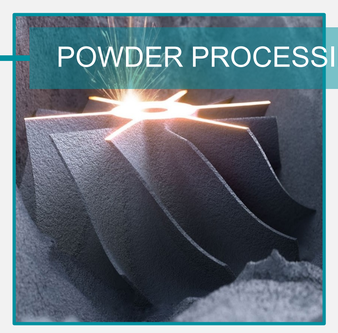


Figure 8: Selective laser melting process.
Source: DMG MORI

QUALITY ASSURANCE II

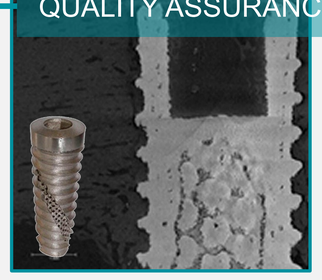


Figure 9: X-ray computed tomography images of a dental implant [7].

- Characterization of interior material structures down to nanoscale
- Multi-scale, multi-technique and high performance/high throughput characterisation …

SERVICE LIFE

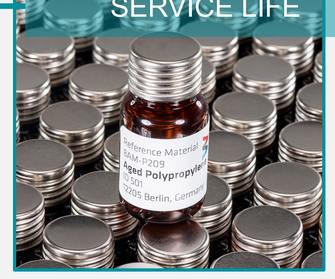


Figure 10: Aged reference materials
Source: BAM

- Methods for material property determination in complex environments (e.g. real word, harsh, rapidly changing conditions) ...

RECYCLING

- Quality/contamination control of pre-used Additive Manufacturing powder
- Digital Product Pass of Advanced Materials with metrology information ...

EMN ACTIVITIES WITH RESPECT TO THE EUROPEAN PARTNERSHIP ON METROLOGY PROGRAMME

EURAMET call process	**Orientation pages requested**	**Call for PRTs*** (opens in Jan.)	**Call for SRTs**** (Jun.)	**Review of JRPs***** (Nov.)	**Runtime of approved Joint Research Projects** (JRPs usually start in June in year after call)		
EMN steering activity	**Writing of orientation pages**	**Planning of PRTs**	**Coordination of SRTs**		**Collaborative projects on industry driven topics**		
EMN main targets		**investigation of SH needs**	**draft SRA**	**EMN Website**	**final SRA**		**sustainable EMN operation**
Timeline	2021	2022	2023	2024	2025	2026	2027

Figure 11: Timeline of EMN activities and European Partnership on Metrology programme. *Potential Research Topic **Selected Research Topic *** Joint Research Projects

CONTACT & NEWSLETTER SUBSCRIPTION

Get in touch via email **advancemanu@euramet.org**
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REFERENCES

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EMPIR EURAMET
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