

## European Nanometrology Strategy 2010



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Supports & promote international competitiveness of EU industry



### Specialisms:

- Ultra/Nano-precision manufacturing;
- Design and build of ultra-precision machine systems;
- Characterisation: metrology systems, instruments and techniques.

Coordinator Co-Nanomet programme

Scientifically and economically nano-metrology is critical to support progress in nanotechnology

Europe must develop the required measurement framework



### Programme Focus:

- Bring together key stakeholders
- Co-ordinate ongoing activity
- Define needs, bring together infrastructure, people and capability
- 2yr programme from 1<sup>st</sup> Jan 2009.

### Nanometrology – a consumer perspective

- “Nobody Told Me I was a Nano-Consumer:” How Nanotechnologies Might Challenge the Notion of Consumer Rights, Jrn of Consumer Policy, H. Throne-Holst and P. Strandbakken Nov 2009.
- ‘Special Message on Protecting the Consumer Interest’ President Kennedy, 1962 defines consumer rights in modern societies as:
  - i) The right to make intelligent choices among products & services
  - ii) The right to have access to accurate information
  - iii) The right to be offered fair prices and acceptable quality
  - iv) The right to have safe and healthful products
- Effective nanometrology invoked by i) to iv) above.

### Motivation:

To address the following issues:

- Low visibility and fragmentation of European metrology infrastructure
- Duplication of efforts across Europe
- Difficult connectivity in the supply chain
- Skills shortage in key areas
- Underused fabrication capacities
- Increasing expense of capital equipment
- Need to define essential requirements for nanometrology to support regulations

### Programme Aims:

- Define a European Strategy for Nanometrology
- Identify and coordinate leading Nanometrology activity across Europe
- Coordinate European training and education of scientists, engineers and end-users in nanometrology
- Create a central hub that provides visibility to new and existing activities across Europe
- Recommend the development of new nanometrology infrastructures across Europe



**Co-Nanomet**  
Co-ordination of Nanometrology in Europe

The Co-Nanomet consortium:



A body of 14 leading expert organisations in the field of nanometrology, nanotechnology, technology transfer and specialised training

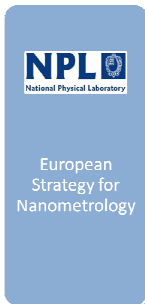
**Co-Nanomet**  
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Core Activities:



**Co-Nanomet**  
Co-ordination of Nanometrology in Europe

Core Activities:



- Review current and emerging needs in support of industrial transformation of nanotechnology.  
*Foresight review completed Nov 2009*
- Issues and opportunities evaluated with key stakeholders  
*Consultation Paper published Feb 2010*  
[www.co-nanomet.eu/consultation](http://www.co-nanomet.eu/consultation)
- Strategy for future activities and developments defined  
*Completion Dec 2010*

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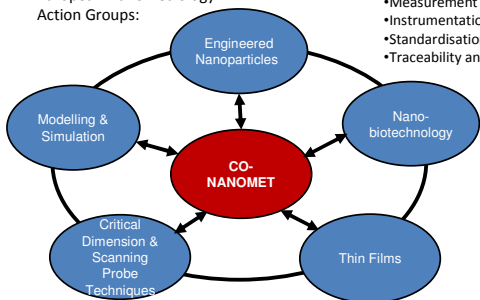
Core Activities:



- 5 European Action Groups established:
  - Engineered Nanoparticles
  - Nanobiotechnology
  - Thin Films
  - Critical Dimension and Scanning Probe Techniques
  - Modelling and Simulation
- Address requirement for focussed activity, share key developments and best practice
- Process chain put in place for the dissemination of metrology techniques
- Traceability to national and international standards will be addressed

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European Nanometrology Action Groups:



- Groups address:
- Measurement technologies
  - Instrumentation
  - Standardisation requirements
  - Traceability and equivalence

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- Discussions 2009
- Engineering Technology Strategy
  - European Technology Strategy
  - Measurement Science and Metrology
  - Other
- Challenges and Future Needs within Europe
- Scanning Probe Microscopy, Scanning Electron Microscopy and Critical Dimension: Nanometrology Status and Future Needs within Europe
- Modelling & Simulation: Nanometrology Status and Future Needs within Europe
- Workshops 2010: [www.co-nanomet.eu/discussionpapers](http://www.co-nanomet.eu/discussionpapers)
- "Instruments, Standard Methods and Reference Materials for Traceable Nanoparticle Characterisation" 28-29 April 2010, Nurnberg, Germany
  - "Measurement Needs and Opportunities in Nanobiotechnology" Workshop, 13-14 April 2010, NPL UK
  - "Nanoscale Calibration Standards and Methods". Dimensional and related measurements in the micro and nanometre range, 27-29 Oct, 2010, Brno, Czech Rep
- [www.co-nanomet.eu/events](http://www.co-nanomet.eu/events)

**Core Activities:**

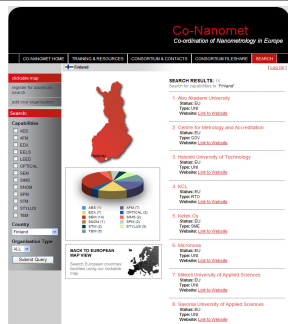


- Nanometrology educational programmes across Europe reviewed
- Directory of training published online
  - Bachelor, post grad, industry, NMI
  - [www.co-nanomet.eu/trainingdirectory](http://www.co-nanomet.eu/trainingdirectory)
- Training needs and recommendations for training curricula 2010
- Training provided in basic nanometrology concepts and standardisation.
  - Training workshop: 'Application of Standards Within Nanometrology '(ENF 2009)
  - Introductory Guide to Nanometrology (2010)

**Core Activities:**



- Map of facilities and capabilities inform both providers and users of nanometrological services.
- Requirements for large infrastructures and capability gaps being assessed.
- Dissemination of traceable nanometrology to the workplace:
  - Traceability and industrial metrology requirements reviewed and developing approaches shared
  - Recommendations in regard to standards to be derived



- Analysis**
- +20 out of 34 NMIs have no visible capability
  - Germany, UK, France, Italy and Spain account for >50% total facilities
  - >75% of facilities within public sector
  - University base single largest contributor to capability
  - Academies of Science in Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovakia provide significant nanometrology access
  - Austria, Germany, Italy and Spain regional government support of research infrastructure has created significant capability

**Future Needs**

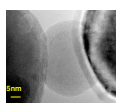
**Critical Dimension and Scanning Probe Techniques:**

- SFM's continue to be an essential tool
- Lateral scanning range needs to be increased (10s mm)
  - large area structured surfaces, wafers and optics
- Resolution to be improved
  - measurement of smaller structures with higher accuracy
- Strategies need to enable 3D probing and scanning
- Fuller understanding of probe-sample interactions,
  - perhaps at a quantum mechanical level

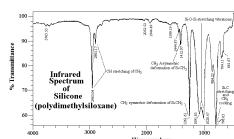
**Future Needs**

**Chemical Nanometrology:**

- Traceable quantification of functional groups in monolayers and multilayers nano-scaled in one or two dimensions
- Imaging techniques that preserve molecular structure whilst depth profiling
- Need to determine the composition of very small quantities of matter or chemical species
  - without prior replication e.g. DNA



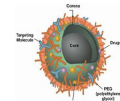
Surface Layers on Nanoparticles



**Future Needs**

**Bionanometrology:**

- Strengthen the contacts between key players in the field
- Biomedical scientist and relevant industry actors more closely engaged in metrology development
- Techniques that offer the highest biomedical and industrial impact should be selected as "cases" for focused metrological development efforts
  - reference materials, best measurement practices, standards and traceability



Molecules on a nanoparticle surface with core, drug layer and targeting molecules

**Thin Films:**

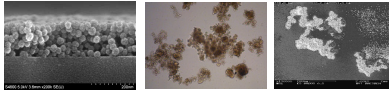
- Measurement gaps exist for functional organic films, porous films

**Nanomaterials:**

- Understanding of transport at the nanoscale or through nanostructured materials

**Nanoparticles:**

- Quantification of uptake, aggregation/agglomeration, chemical and structural stability
- Measurement of the distribution of such particles/agglomerates both in-vitro and in-vivo



Porous nanocolloidal thin films, nanoaggregates and agglomerates

- Needs and opportunities addressed : chemical, bio, dimensional, thin film and nanostructured materials
- Skills and infrastructure coordination
- Opportunity to contribute to European strategy
- Training and resources available

White papers, training directory, capabilities map ...

[www.co-nanomet.eu](http://www.co-nanomet.eu)

