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Nordic Innovation Centre

# POSITION PAPER



**Nordic pre-normative research  
in relation to international development of  
nanotechnology standards**

<b>Authors:</b> Leslie Pendrill <sup>1</sup> Lars Lading <sup>2</sup> Andreas Vogl <sup>3</sup> Ilkka Tittonen <sup>4</sup> Toomas Kubarsepp <sup>5</sup> Andy Henson <sup>6</sup> Håkan Nilsson <sup>1</sup>	<b>Nordic Innovation Centre Project number:</b> 05023  <b>Institutions:</b> <sup>1</sup> SP (SE) <sup>2</sup> Sensor Technology Centre (DK) <sup>3</sup> SINTEF (NO) <sup>4</sup> Micronova Ltd (FI) <sup>5</sup> Metrosert ltd (EE) <sup>6</sup> NPL (UK)
<b>Title:</b> <b>Nordic pre-normative research in relation to international development of nanotechnology standards</b>	
<b>Abstract:</b> <p>The Nordic NanoTrade group, initiated with the support of the Nordic Innovation Centre (NICE), aims to promote national, regional, European and international work in the area of R&amp;D and standardisation in nanotechnology as being of critical importance for realising the full potential of nanotechnologies for human beings and industry.</p> <p>In considering Nordic pre-normative research in relation to international development of nanotechnology standards, concerning in particular terminology &amp; nomenclature; measurement &amp; characterisation of nanosystems; health, safety and environmental impact and product and process standards, the following key recommendations and key actions are deemed essential:</p> <ol style="list-style-type: none"> <li>1. Establish a collaborative platform to promote proactively international cooperation in pre-normative R&amp;D in nanotechnology.</li> <li>2. Participate in core groups active in projects proposed to EU Commission for nanotechnology standardisation and related research.</li> <li>3. Contribute actively to on-going national, regional, European and international standardisation and research in nanotechnology.</li> <li>4. Strengthen the Nordic nanotechnology standardisation group.</li> </ol> <p>There are extensive tables of both nanotechnological objects (such as particles) and metrological methods in the new CEN strategy. Existing and required standardisation in micro- and nanosystems has been mapped in an earlier EU project MEMSTAND.</p> <p>In a Nordic perspective, Nordic NanoTrade suggests a prioritisation of the following additional subjects for standardisation:</p> <ul style="list-style-type: none"> <li>▪ Nanoanalytics for biotechnology</li> <li>▪ Nanoscale coatings and films for sensors/actuators/electronics</li> <li>▪ Nanopatterned surfaces and nanohardness (including both material property as well as nanoindenter).</li> </ul>	
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## 1. Executive summary

Much has been said about the predicted spectacular growth in nanotechnological production in the coming years. In order to sustain such growth, a considerable investment in technological and manufacturing/business infrastructure is needed. The global race to invest in nanotechnology R&D is already creating many new products and processes, and both the research effort and the predicted market activity is conservatively forecast to be hundreds of milliards of Euros. This growing trade will generate the need for new standards, but there is a potentially large risk to Nordic industry of unnecessary costs and duplicate work if one does not follow the international standardisation development.

The Nordic NanoTrade<sup>1</sup> group, initiated with the support of the Nordic Innovation Centre (NICe), aims to promote national, regional, European and international work in the area of R&D and standardisation in nanotechnology as being of critical importance for realising the full potential of nanotechnologies for human beings and industry. The NanoTrade group represents a wide and comprehensive constituency in the area of nanotechnology in the Nordic (and Baltic) region with a focus on pre-normative research.

In considering Nordic pre-normative research in relation to international development of nanotechnology standards, the following key recommendations and key actions are deemed essential:

1. Establish a [collaborative platform](#) to promote proactively international cooperation in pre-normative<sup>2</sup> R&D in nanotechnology.
2. Participate in core groups active in projects [proposed to EU Commission](#) for nanotechnology standardisation and related research.
3. Contribute actively to on-going national, regional, European and [international standardisation](#) and research in nanotechnology.
4. Strengthen the [Nordic nanotechnology standardisation](#) group.

A unique opportunity for proactive standardisation development and for developing and introducing standardised characterisation methods in nanotechnology needs to be seized as a matter of urgency – before national and regional positions become fixed.

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<sup>1</sup> *Nordic NanoTrade*: SP (SE, coordinator); Sensor Technology Centre (DK); SINTEF (NO); Micronova Ltd (FI); Metroser Ltd (EE), NPL (UK) resp. national coordinators, NICe project 05023, April – Sept. 2005

<sup>2</sup> “Pre-normative research: R&D likely to generate new matters for standardisation, usually in advance of these activities, (i.e. work anticipating future standards)”<sup>14</sup>

## 2. Pre-normative R&D in nanotechnology

Nanotechnology has a unique opportunity for **proactive standardisation development** since the technology is still in its infancy.

The expected considerable growth in nanotechnology will require major infrastructural investment, especially the development and introduction of new standards in nanotechnology. Few such standards exist today and whole new ranges of nanotechnological products will appear. Infrastructure ensures that newly developed products will satisfy the exacting requirements not only of scientific excellence but also of reliability and economy when practically implemented. It is becoming urgent that the standardisation needs for Europe for nanotechnology are reviewed in consultation with key stakeholders so as to facilitate industrial take up and development by providing harmonised quality standards and measurement techniques<sup>3</sup>. This will also contribute towards making nanotechnological products can be traded freely and are safe and thus to gain users' and **consumers' confidence**.

Above all, there is a commensurate need for **research** – both pre-normative and co-normative – in developing and introducing standardisation in nanotechnology. It is indeed well known that standardisation activities benefit from, and in some cases absolutely need, specific research, such as in determining the reliability of envisaged testing methods<sup>4</sup>.

Despite an obvious need, there are however **few Nordic universities or industries** today engaged in this infrastructural area. The unique opportunity for proactive standardisation development and for developing and introducing standardised characterisation methods in nanotechnology needs to be seized as a matter of urgency – before national and regional positions become fixed.

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<sup>3</sup> EU Communication COM(2004) 338 'Towards a European strategy for nanotechnology'; EU Action Plan on Nanotechnology and Exploratory meeting for "responsible" R&D in nanotechnology, 14 – 15 July 2005 Brussels, [www.cordis.lu/nanotechnology/src/intldialogue.htm](http://www.cordis.lu/nanotechnology/src/intldialogue.htm)

<sup>4</sup> CEN/BOSS "Guidance - TC research in the context of EC funding"  
<http://www.cenorm.be/boss/supporting/guidance+documents/gd038+-+tc+research+in+the+context+of+ec+funding/gd+-+tc+research.asp>

### 3. Recommendations

In considering Nordic pre-normative research in relation to international development of nanotechnology standards, the following key recommendations and key actions are deemed essential.

#### 3.1. Establish a collaborative platform for pre-normative R&D

Each NanoTrade national contact has been in touch with principal actors in nanotechnology, particularly those involved with research and/or standardisation. Information has been given about the NICe Nordic NanoTrade pre-project; stakeholders have been asked for their [views on pre-normative research in nanotechnology](#) and these have provided material in formulation of a [proposed work programme](#), road-map and position paper.

Examples of organisations on the Nordic NanoTrade mailing list are: the National Standards Body, the National Metrology Institute; university nanogroups; and companies, both large and small. Each Nordic country is developing national nanotechnology networks at various stages of evolution. A new national nanotechnology network is being established in **Denmark**, including over forty companies such as large companies like Novozymes A/S and Danfoss A/S, and small start-ups like Cantion and Koheras. Several Danish knowledge centres have a strong interest in the topics of the project including the Danish Technological Institute, DELTA, DFM, Bioneer A/S, Sensor Technology Center A/S (STC), Mikroelektronik Centret (MIC), Institute for Production and Management at the Danish Technical University (DTU). To facilitate and enhance the collaborative platform, a Nanotechnology Technical Committee has just been established (Sept. 2005) at the **Estonian** Centre for Standardisation aimed at concentrating available competence in R&D for pre-normative activities in the field of nanotechnology. The founder members were Tallinn University of Technology, University of Tartu and Metersert Ltd. In **Finland**, MICRONOVA, leading research centre for micro- and nanotechnology, contains research groups from Helsinki University of Technology (HUT) and Technical Research Centre of Finland (VTT). In **Norway** the research council is working at the moment to establish a national strategy plan for nanotechnology to be built on the different strategies research institutes, universities and different industrial stakeholders already have, but nevertheless would be more comprehensive. SINTEF, which has done considerable work within its own strategy process to understand the upcoming needs within the industry, intends to play an important role in the Norwegian national strategy process, clarifying industrial needs for pre-normative research as a part of the general research process. To quote from a **Swedish** popular magazine: “Behind the nano concept are enormous technological possibilities; inflated expectations and a considerable amount of scepticism, particularly from industry. Swedish industry is hardly queuing to get the results of world-leading research. Are we researching the wrong things or doesn't industry see the possibilities? Or is nanotechnology not yet mature enough?”<sup>5</sup>

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<sup>5</sup> <http://www.nyteknik.se/tavling/index.asp>

### 3.2. Proposals to EU Commission

The NanoTrade group has collaborated actively with at least two groups preparing EU proposals about standardisation and research for nanotechnology:

#### 3.2.1. *Main EU Commission Call for Proposals, NMP-2004-3.4.1.1-2 - Standardisation for nanotechnology (SSA deadline 15 Sept. 2005)*

One consortium, lead by LNE (FR), closely connected to CEN and other European and International standardisation organisations, has taken a 'top-down' approach with a fairly comprehensive coverage of standardisation related to nanotechnologies. The NANO-STRAND proposal aims to develop a road map of European standardisation and pre-normative research work for nanotechnologies and to enable Europe to play an active role internationally in standardisation and nanotechnologies. Nordic NanoTrade has offered to provide one of its members to the Advisory committee of the NANO-STRAND project which is under evaluation by EC.

#### 3.2.2. *EU Commission Call for Proposals, FP6-2005-INNOV-8, Standards in Support of Innovative Business Solutions*

The Nordic NanoTrade has also contributed to a proposal to the EU Commission called "ASPECT - Applying Standards to innovative design and development of Products and service, and the impact on Emerging, Commercially viable healthcare Technologies".

### 3.3. Contribute actively to on-going national, regional, European and international standardisation and research in nanotechnology

The Nordic NanoTrade group has participated actively in continued work of CEN BT/WG166 Nanotechnology group, particularly at its meeting 050415 in Delft (NL) and in the formulation of a draft strategy for European standardisation for nanotechnologies. Latest versions of the CEN and corresponding ISO strategies<sup>6</sup> identify that Nanotechnology in its myriad of applications will need standardisation regarding:

1. Terminology & nomenclature
2. Measurement & characterisation of nanosystems
3. Health, safety and environmental impact
4. Product and process standards

In several of these, pre-normative research is also needed, such as in the development of new measurement and characterisation methods. Nordic NanoTrade has therefore suggested adding a fifth Working Group to manage co-ordination of standardisation research activities. This would go some way to solve the challenges mentioned elsewhere in the draft Strategy associated with the 'huge amount of work' involved, to quote from the CEN strategy.

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<sup>6</sup> CEN 2005 "A strategy for European standardisation for nanotechnologies", Document CEN/BT/WG 166/N39 submitted to CEN/BT for approval; ISO TC229 'Nanotechnologies'  
<http://www.iso.org/iso/en/stdsdevelopment/tc/tclist/TechnicalCommitteeDetailPage.TechnicalCommitteeDetail?COMMID=5932>

A new EU ERA-NET project iMERA “Implementing Metrology in the European Research Area”<sup>7</sup> has started, motivated by amongst others emerging technologies such as nanotechnology. The aim is to meet increased demands for quality-assured measurement by active co-operation in research amongst European measurement standards organisations such as EUROMET and principal stakeholders. We would encourage the standardisation bodies involved in nanotechnological standardisation to make contact with the iMERA project (co-ordinator NPL) to discuss co-ordination. Members of the Nordic NanoTrade group gave a presentation at the International Métrologie 2005 conference<sup>8</sup>.

### 3.4. Strengthen the Nordic nanotechnology standardisation group

When contacting the national standards bodies in the Nordic area, NanoTrade has referred to a new Nordic project sponsored by the Nordic Innovation Centre, aimed at increasing co-ordination between the Nordic national standards bodies<sup>9</sup>. NanoTrade proposes that a possible continuation could be a nanostandardisation pilot project within the framework of this new NICE initiative.

While world-wide nanostandardisation activities are carried out within the frameworks of ISO and CEN, it is obvious that those actions are reflected in Nordic nanotechnology standardisation group to support regional businesses in global competence by taking advantages of knowledge transfer and the completion of specific written standards.

#### 3.4.1. Summary of Stakeholder Survey

A brief two-week survey of stakeholders’ interest in nanotechnological pre-normative R&D which was conducted during this Nordic NanoTrade project had a relatively weak response rate and any conclusions from the survey would not be statistically representative. It could be argued that this lack of response might be due more to a general feeling of 'saturation' in the wake of earlier surveys<sup>10</sup> rather than a genuine lack of interest. Most responses to the NanoTrade survey came from Estonian organisations, mainly in the R&D and measurement and standardisation sectors, including the Estonian Nanotechnology Competence Centre, the Tallinn University of Technology (Dept. of Materials Technology), an instrument manufacturer (Maico Metrics) and the Estonian Centre for Standardisation. Pre-normative R&D in nanotechnology and exploiting and disseminating nanotechnological opportunities dominated the activities of the Estonian respondees. Few existing standards were deemed applicable to nanotechnology while there was some awareness of European and international nanotechnological standardisation in progress.

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<sup>7</sup> project iMERA “Implementing Metrology in the European Research Area”  
<http://www.euromet.org/projects/imera/>

<sup>8</sup> Henson A and Pendrill L R 2005 “Global R&D for global nanotechnology standards”, MÉTROLOGIE 2005 conference (EUROMET session), Lyon (FR) 20<sup>th</sup> June <http://www.cfimetrologie.com>

<sup>9</sup> ‘Øget samarbejde og ny arbejdsdeling mellem standardiseringsorganisationerne i Norden’,  
<http://www.nordicinnovation.net/article.cfm?id=1-834-648>

<sup>10</sup> Nanoforum.org “Nanotechnology in the Nordic Region”, June 2003, <http://www.nanoforum.de>;  
CEN/BT/WG 166 “Nanotechnologies – Industrial Consultation Questionnaire” Oct. 2004

#### 4. Proposed work programme and road map for standards development in nanotechnology

There are extensive tables of both nanotechnological objects (such as particles) and metrological methods in the new CEN strategy<sup>11</sup>. Existing and required standardisation in micro- and nanosystems has been mapped in an earlier EU project MEMSTAND<sup>12</sup>.

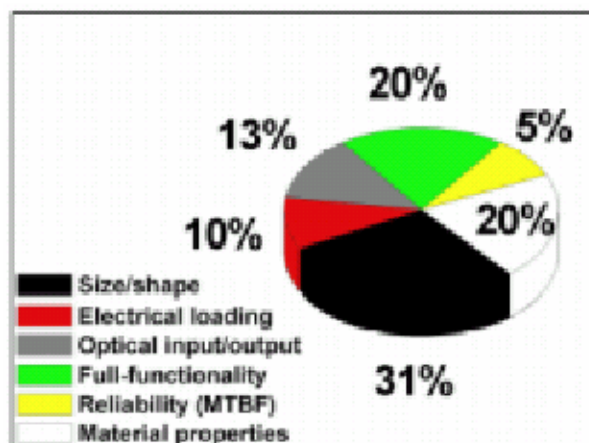


Figure 1 Material properties of microsystems<sup>13</sup>

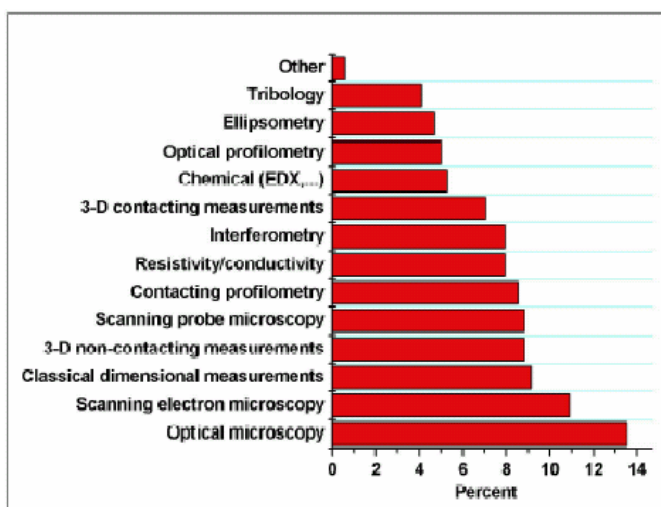


Figure 2 Measurement types for microsystems<sup>14</sup>

Nordic NanoTrade has mentioned, in part a result of the Nordic survey, additional subjects for standardisation, including Nanoanalytics for biotechnology; Nanoscale coatings and films for sensors/actuators/electronics; Nanopatterned surfaces and nanohardness (including both material property as well as nanoindenter). An example

<sup>11</sup> CEN 2005 “A strategy for European standardisation for nanotechnologies”, Document CEN/BT/WG 166/N39 submitted to CEN/BT for approval.

<sup>12</sup> “MEMSTAND – Standardisation for Microsystems: the way forward”, [www.memstand.org](http://www.memstand.org)

<sup>13</sup> <http://www.memstand.org/microsystems-technology-standardisation-roadmap.pdf>, fig. 4

<sup>14</sup> <http://www.memstand.org/microsystems-technology-standardisation-roadmap.pdf>, fig. 5

of a response to the NanoTrade survey was from a West Swedish SME<sup>15</sup> which manufactures manipulation and measurement tools for transmission electron microscopy users. They saw a need within 1 – 3 years to develop improved standards concerning: handling/safety/toxicology and disposal/environmental risks of nanoparticles/tubes; calibration, data acquisition and probe characterisation methods for scanning probe microscopes; sample preparation, magnification and detector energy-scale calibration in analytical electron microscopy; as well as metrology across in principle all measurement quantities (mass, force, flow rate, etc).

Nordic NanoTrade has emphasised that a matrix (Table 1) showing the links between nanoobjects and measurement methods is useful, and that future international standardisation and pre-normative R&D in nanotechnology should have a coordinated approach covering both object-related and metrological aspects.

Table 1 Matrix of nanotechnological objects and metrological methods

<b>Object \ Metrology</b>	<b>mass</b>	<b>optics</b>	<b>electricity</b>	<b>pH</b>
Np/Nt/Nf <sup>16</sup> -physical properties	x	<b>x</b>	x	x
Nscoatsfilm <sup>17</sup> for sensors/actuators/electronics	x	x	<b>x</b>	<b>x</b>
Etc				

<sup>15</sup> Nanofactory Instruments AB <http://www.nanofactory.com/>

<sup>16</sup> Np/Nt/Nf– nanoparticle/nanotube/nanofibre

<sup>17</sup> Nscoatsfilm – nanoscale coatings and films



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## Nordic Innovation Centre

The Nordic Innovation Centre initiates and finances activities that enhance innovation collaboration and develop and maintain a smoothly functioning market in the Nordic region.

The Centre works primarily with small and medium-sized companies (SMEs) in the Nordic countries. Other important partners are those most closely involved with innovation and market surveillance, such as industrial organisations and interest groups, research institutions and public authorities.

The Nordic Innovation Centre is an institution under the Nordic Council of Ministers. Its secretariat is in Oslo.

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