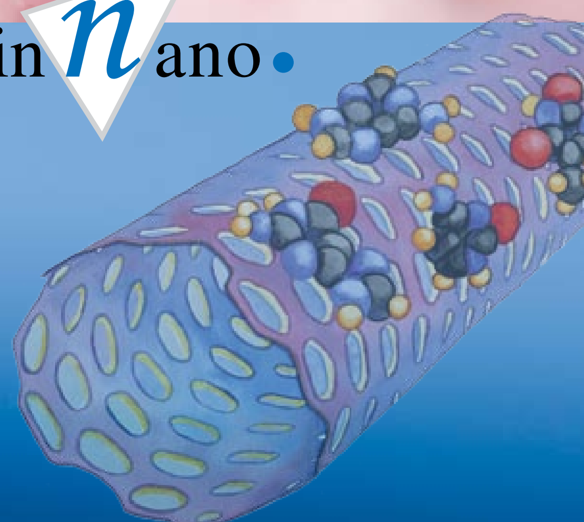
Research Programme on Nanoscience

FinNano

Academy of Finland
Research Programme
FinNano 2006–2010



Academy of Finland
Research funding and expertise

Research Programme on Nanoscience FinNano 2006–2010

FinNano in brief

Behind research on nanoscale phenomena and structures there is scientific curiosity, but also visions for new products and services that may bring sustainable development and competitiveness in the community. Nanoscience is developing rapidly. This is partly because physics, chemistry and life sciences methods are being applied simultaneously. This research programme will produce new scientific information that hopefully will bring faster and more powerful technologies as well as new materials and devices. The interdisciplinary thematic areas are self-assembly, functionality and properties of nanoscale objects.

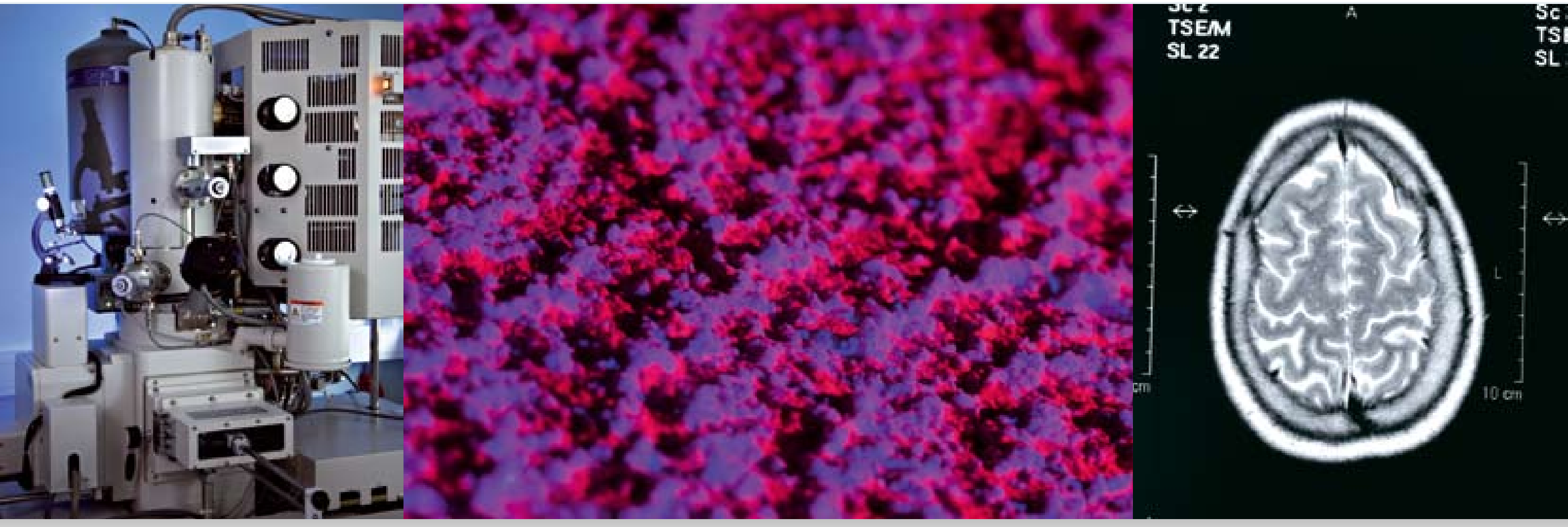
OBJECTIVES

- Support high-level research on nanoscience as part of the innovation environment
- Activate interdisciplinary and transdisciplinary approach in the field
- Develop research environments and researcher training in the field
- Create real added value for research groups participating in the programme by means of networking, international visibility and application of research results
- Advance responsible development of nanotechnology – the research programme will take into account ethical challenges, i.e. safety, health and environment-related matters
- Advance European and other international activity and mobility in the field

THEMATIC AREAS

When the FinNano research programme was outlined the starting point was genuinely interdisciplinary research. Research projects could not be built on a single discipline or engineering perspective. New and innovative, i.e. conceptually novel proposals as well as open-minded methods, were the primary goals.

The research projects deal with nanoscience-related phenomena and objects. Nanoscience was not defined unambiguously, but the observation that one's research is related to the nanometre size range was not a sufficient prerequisite. Research had to focus on novel properties and functions. Traditional research on chemistry, physics and life sciences, as such, did not fulfil the characteristics of nanoscience here.



Directed self-assembly

Self-assembly is a universal property created by molecular structure and to a certain extent also by atomic structure. Positive interaction forces direct the relative orientation of molecules or atoms without any additional directioning. There are two kinds of self-assemblies, namely intramolecular (e.g. in protein folding) or intermolecular (e.g. in creation of a micelle). Self-assembly is among the basic phenomena in nature because most of the biological processes are based on it. It increases organisation of a system, but because the intermolecular forces are non-covalent, the created organisation is dynamic and self-correcting. By directed self-assembly the self-organisation processes can be realised in a designed way, if only the interactions between molecules are properly known. Self-assembly can act as a builder of system components, and in that sense allow creation and utilisation of nanosized either non-covalent dynamically acting or covalent non-dynamically acting systems.

Functionality in nanoscience

The functions on the nano level differ considerably from those on the macro and microlevel. Miniaturisation of a functional unit to 1–100 nm scale or a function scale to be reduced to within a few nanometres has opened totally new possibilities to apply nanoscale processes. Numerous biological and chemical phenomena are occurring on the nanoscale, and in nature there is optimal utilisation of functional processes on the nanoscale, which has been developed for billions of years. This thematic area aims to target research at nanoscale functional processes. This research is aimed at understanding, designing and creating nanoscale functional units to be used in different processes such as transfer, storage, transport, fault-healing and reorganisation of information and energy.

Properties of single nanoscale objects

This thematic area is for research projects that are not naturally related to the two other areas. Nanoscale

objects' (molecules or nanoparticles) chemical and physical properties are the foundation of nanoscale processes. The research in this thematic area focuses on investigating these nano-object properties. Structural changes occurring in a nano-object (e.g. conformational changes in enzyme), storage of information/energy and transfer to another nano-object are all important basic processes in nature. The small size of the nano-objects can also be a problem. The possible harmful interactions of artificial nanomolecules and nanoparticles with biological material are consequences of the nanoparticle properties.

Photos: Amarantti/Visa Vehmanen, futureimagebank.com, kuvakori.com

Illustration: Amarantti/Suvi Vanhanen

Layout: Sole Lätti

Yliopistopaino, Helsinki 2007

FUNDED PROJECTS

Biologically Guided Nanoparticles – Targeting, Safety and Imaging Technology (BIOTARGET)
Jyrki Heino, University of Turku
Ralph-Johan Back, Åbo Akademi University
Sirpa Jalkanen, University of Turku
Mika Lindén, Åbo Akademi University

Nanodevices Using Functionality in Ferroelectrics (FERNAND)
Marina Tjunina, University of Oulu
Markku Leskelä, University of Helsinki
Risto Nieminen, Helsinki University of Technology

Functional Nanoparticles and Devices (FUNANO)
Jouko Korppi-Tommola, University of Jyväskylä
Konstantin Arutyunov, University of Jyväskylä
Lauri Kettunen, Tampere University of Technology
Markku Leskelä, University of Helsinki
Ilari Maasilta, University of Jyväskylä
Matti Manninen, University of Jyväskylä
Sorin Paraoanu, University of Jyväskylä

Molecular Electronics and Nanoscale Photonics (MEP)
Päivi Törmä, University of Jyväskylä
Markus Ahlskog, University of Jyväskylä
Hannu Häkkinen, University of Jyväskylä
Matti Kaivola, Helsinki University of Technology
Henrik Kunttu, University of Jyväskylä
Maija Nissinen, University of Jyväskylä
Mika Pettersson, University of Jyväskylä

Nanopatterned, Functional Surfaces by Design (NANOFUSED)
Mika Lindén, Åbo Akademi University
Sami Areva, University of Turku
Tuula Pakkanen, University of Joensuu
Ronald Österbacka, Åbo Akademi University

Engineered Nanoparticles: Synthesis, Characterization, Exposure and Health Hazards (NANOHEALTH)
Kai Savolainen, Finnish Institute of Occupational Health
Harri Alenius, Finnish Institute of Occupational Health
Kaarle Hämeri, Finnish Institute of Occupational Health
Jorma Joutsensaari, University of Kuopio
Hannu Norppa, Finnish Institute of Occupational Health
Pertti Pasanen, University of Kuopio

Mechanical Properties of Nanostructures (NANOTOMO)
Roman Nowak, Helsinki University of Technology
Juhani Keinonen, University of Helsinki
Ari Lehto, Helsinki University of Technology
Kai Nordlund, University of Helsinki
Markus Pessa, Tampere University of Technology

Optical and Surface Properties of Nanoparticles (OPNA)
Markku Räsänen, University of Helsinki
Juhani Keinonen, University of Helsinki
Markku Kulmala, University of Helsinki
Ari Laaksonen, University of Kuopio
Jouko Lahtinen, Helsinki University of Technology
Ari Lehto, Helsinki University of Technology
Kai Nordlund, University of Helsinki
Sergey Novikov, Helsinki University of Technology
Dage Sundholm, University of Helsinki

Enhanced Therapeutic Effects via Intelligent Peptide-loaded Nanoparticles (PEPBI)
Kristiina Järvinen, University of Kuopio
Karl-Heinz Herzig, University of Kuopio
Jorma Joutsensaari, University of Kuopio
Vesa-Pekka Lehto, University of Turku

Multiscale Modelling of Biopolymer Translocation through Nanopores (TRANSPOLY)
Tapio Ala-Nissilä, Helsinki University of Technology
Mikko Karttunen, Tampere University of Technology
Riku Linna, Helsinki University of Technology
Ilpo Vattulainen, Tampere University of Technology

INTERNATIONAL JOINT PROJECTS

Thermal Effects in Nanoscale Superconducting Functions (NANOFRIDGE)
Jukka Pekola, Helsinki University of Technology
Other partners (funded by other NanoSci-ERA partners):
Hervé Courtois, CRTBT-CNRS, Grenoble, France (consortium leader)
Francesco Giazotto, NEST and SNS, Pisa, Italy
Teun Klapwijk, TU Delft, The Netherlands

Optical Investigations of Novel Carbon Nanohybrid Material – NanoBuds (Fullerene Functionalized Carbon Nanotubes)
Esko Kauppinen, Helsinki University of Technology
Funded by the Russian Foundation for Basic Research:
Elena Obraztsova, Natural Sciences Center of General Physics Institute, Russian Academy of Sciences

Optical Investigation of the Structure and Dynamics of Functional Nanomaterials
Helge Lemmetyinen, Tampere University of Technology
Funded by the Russian Foundation for Basic Research:
Michael G. Kuzmin, Moscow State University, Russia

Optical Properties of GaN and GaAsN Nano- and Microstructures in Terahertz Spectral Range
Harri Lipsanen, Helsinki University of Technology
Funded by the Russian Foundation for Basic Research:
Dmitry A. Firsov, Saint-Petersburg State Technical University, Russia

Optical Properties of Metallic Metamaterials
Sergei Tretyakov, Helsinki University of Technology
Funded by the Russian Foundation for Basic Research:
Vyacheslav V. Popov, Saratov Institute of Radiotechnics and Electronics, Russian Academy of Sciences

Further information

Academy of Finland

Dr Petri Ahonen
Programme Manager
petri.ahonen@aka.fi

Academy of Finland, tel. +358 9 774 881

Programme website: www.aka.fi/finnanoeng

Cooperation partners and other funding agencies:

FinNano

nanoScience Europe

Academy of Finland
Research funding and expertise

Vilhonvuorenkatu 6 • POB 99, FI-00501 Helsinki, Finland
Tel. +358 9 774 881 • Fax +358 9 7748 8299
www.aka.fi/eng • keskus@aka.fi