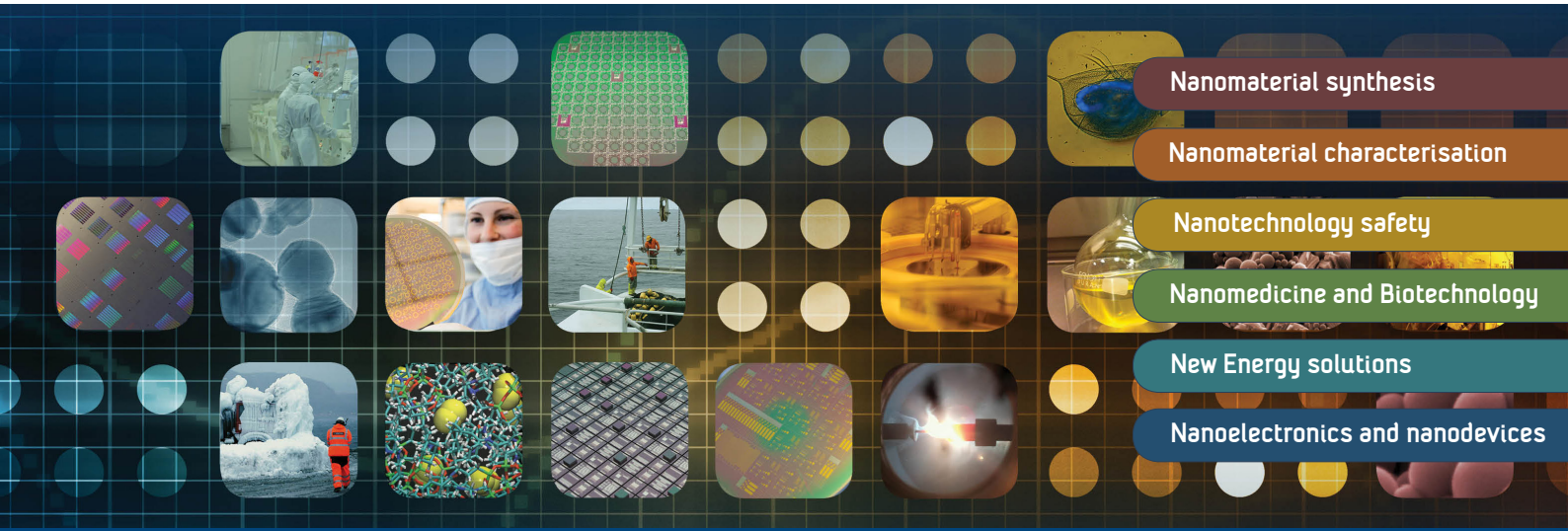
SINTEF

SINTEF Materials and Chemistry

Nanoscience, Nanotechnology and Nanoapplications



SINTEF Materials and Chemistry

SINTEF is Scandinavia's largest independent research group. We create value through knowledge, research and innovation and develop solutions and technology that are used by industry and public sector. Together with customers and partners, we work for increased and sustainable value creation based on R&D.

The SINTEF Materials and Chemistry division specialises in materials- and nano-technology, applied and analytical chemistry, biotechnology and environmental sciences.

SINTEF establishes cross-disciplinary project teams according to your needs, with committed and skilled employees, highly competent in nanosciences, physics, chemistry and biology.

Executive Vice President Torstein Haarberg together with former and present employees at SINTEF Materials and Chemistry

SINTEF has excellent contacts with Norwegian industry in the market areas of Biotechnology and nanomedicine, Environmental technology, Sustainable energy technology, Industrial process technology, Oil and gas, and Materials.

Nanoparticle synthesis

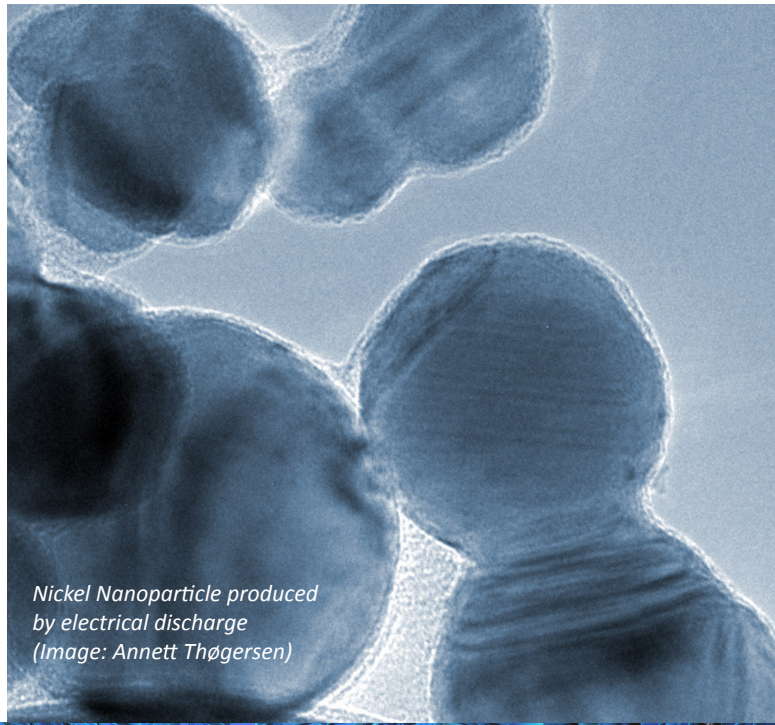
Nanoparticles can improve large-scale technologies in materials, environmental protection and energy management.

SINTEF has capabilities to produce a wide range of different nanoparticles:

- Metal and alloy nanoparticles by electrical discharge and chemical reduction synthesis
- Oxide nanoparticles in polar and non-polar solvents by solvothermal and sol-gel synthesis

Application examples:

- Catalysts
- Hybrid membranes for separation
- Fuel cell electrodes
- Polymer additives to control gas transport, surface wettability and mechanical strength



Nickel Nanoparticle produced by electrical discharge (Image: Annett Thøgersen)

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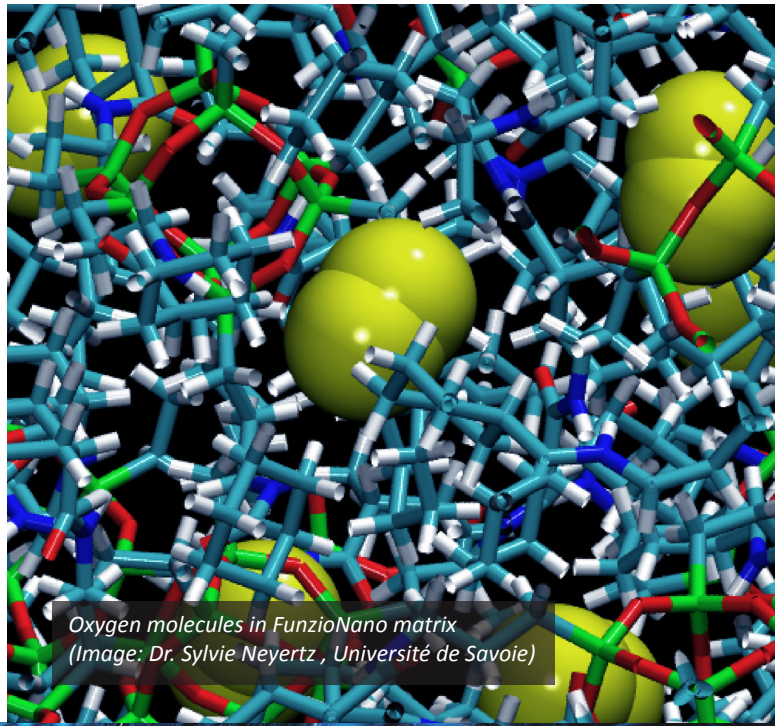
FunzioNano™ synthesis

The FunzioNano™ technology has its basis in a cost effective synthesis of organic/inorganic nanostructured hybrid polymers.

The nanostructures can be given a variety of chemical surface functionalities which can give polymer matrix materials improved or entirely new properties.

Already applied as:

- Air-drying binder
- Part in nanocomposite
- Cross-linker
- Oxygen barrier
- Rheology modifier
- Lubricant
- Emulsifier



Oxygen molecules in FunzioNano matrix
(Image: Dr. Sylvie Neyertz , Université de Savoie)

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Characterisation of nanomaterials

SINTEF employs a broad range of advanced characterisation methods:

- Electron microscopy: new, state-of-the-art TEM instruments, incl. probe and image corrected
- Electron spectroscopy: new XPS and AES
- Mass Spectrometry: a wide range of techniques, incl. new ToF SIMS and FT-ICR MS
- Optical spectroscopy: a range of techniques
- NMR – recent installation of state-of-the-art laboratory for solid state materials research
- Modelling by DFT is used to complement experimental characterisation
- Sample preparation and handling: FIB, ion-milling, metallography, electropolishing, wedge-polishing, inert transfer

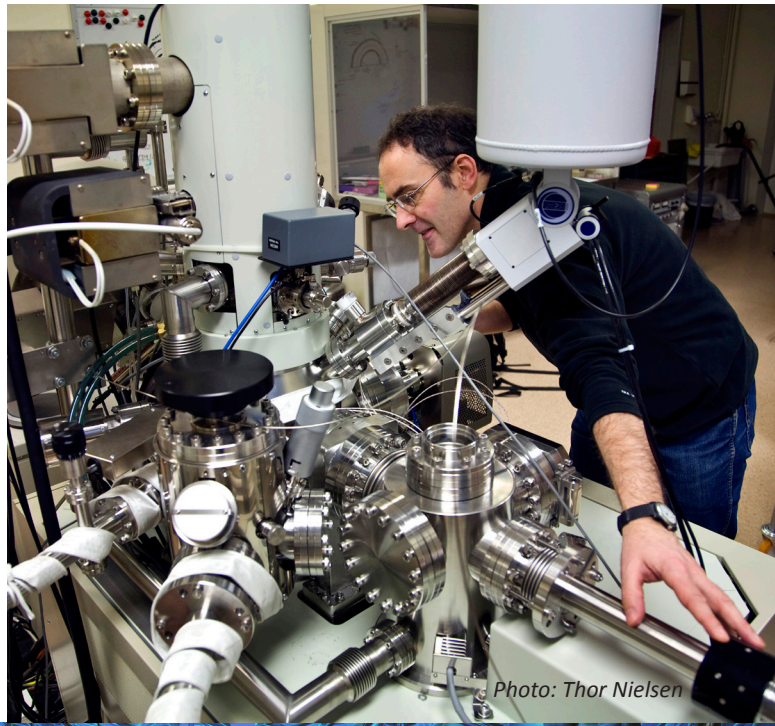

Photo: Thor Nielsen

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Nanotechnology safety

SINTEF has many years of research experience in topics related to environmental and societal issues which are now being applied to nanotechnology:

- 'Safety by design' approach for nanomaterials
- Environmental behaviour and transport of nanomaterials
- Ecotoxicological impacts of nanomaterials
- *In vitro* cell-based assays for characterisation of cellular responses to exposure to nanomaterials
- Risk assessment and environmental impact factors (EIFs)
- Development of tools for modelling pollutant behaviour, transport and toxicity in the environment

Fluorescently labelled polymeric nanoparticles in the gut of Daphnia magna (Image: Dag Altin)

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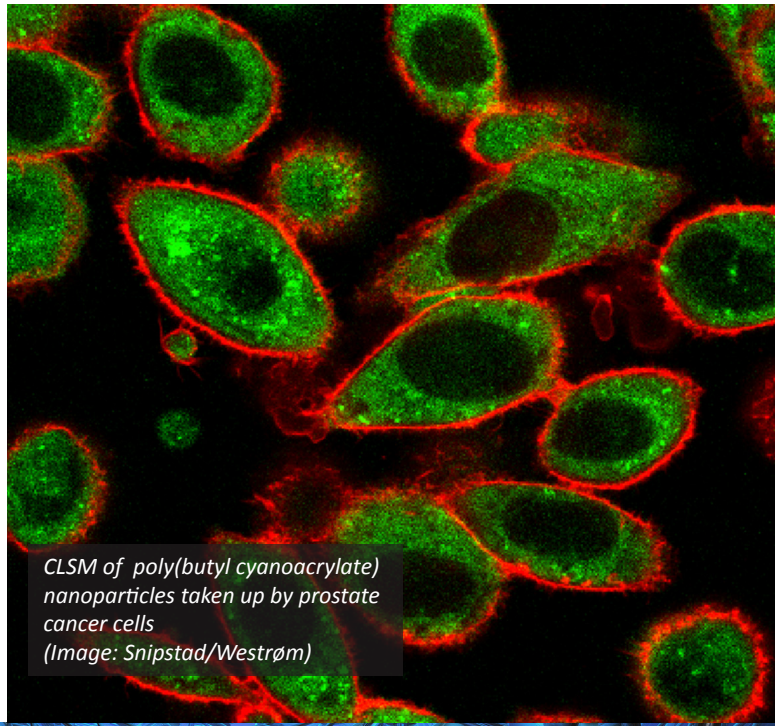
Nanomedicine and biotechnology

Nanomedicine holds promise for rationalised, personalised and highly targeted treatment of diseases. Although biotechnology is a mature field in its own right, the full understanding of biotechnological processes on the single-molecule (nano) level adds greatly to its applicability and societal value.

SINTEF expertise in nanomedicine and nanobiotechnology includes:

- Synthesis and characterisation of multimodal nanoparticles for targeted drug delivery and imaging
- Tailoring of biopolymer primary structure for antimicrobial nanomedicine
- Synthesis, application and characterisation of hybrid organic-inorganic functionalised nanoparticles for antifouling and anti-biofilm purposes



CLSM of poly(butyl cyanoacrylate) nanoparticles taken up by prostate cancer cells
(Image: Snipstad/Westrøm)

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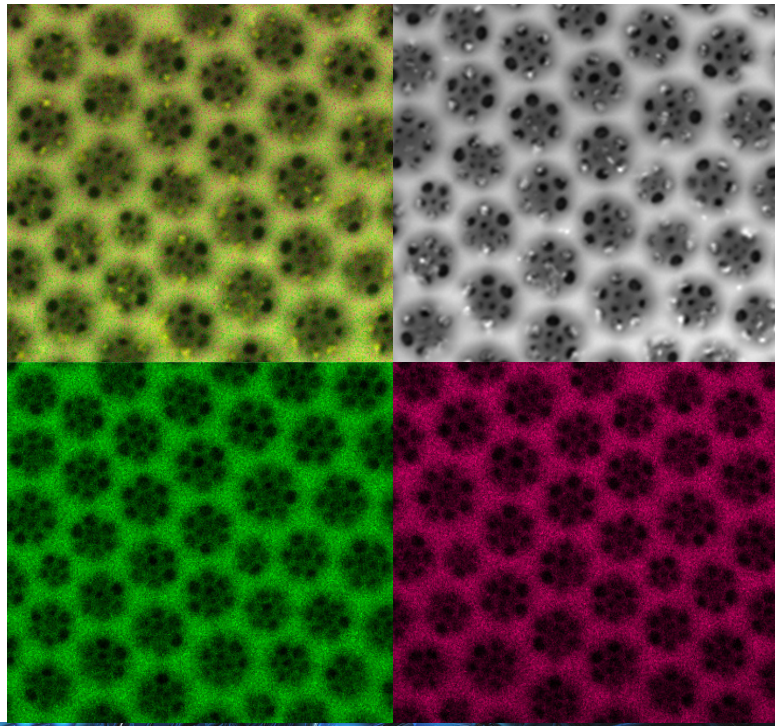
Nanotechnology for energy solutions

SINTEF develops novel nanomaterials and solutions for the energy challenges of today and tomorrow.

We use advanced chemical and physical synthesis routes and characterisation methods to develop and tailor nanosized and nanostructured materials for energy conversion applications:

- Solar Cells
  Thin films and additive technologies
- Fuel Cells and Water electrolysis
  Metal oxide supported nano structured catalysts
- Battery Materials
  Nanostructured composite electrode materials



Silver particles on a Coscinudiscus structure
(Image: Sidsel Hanetho)

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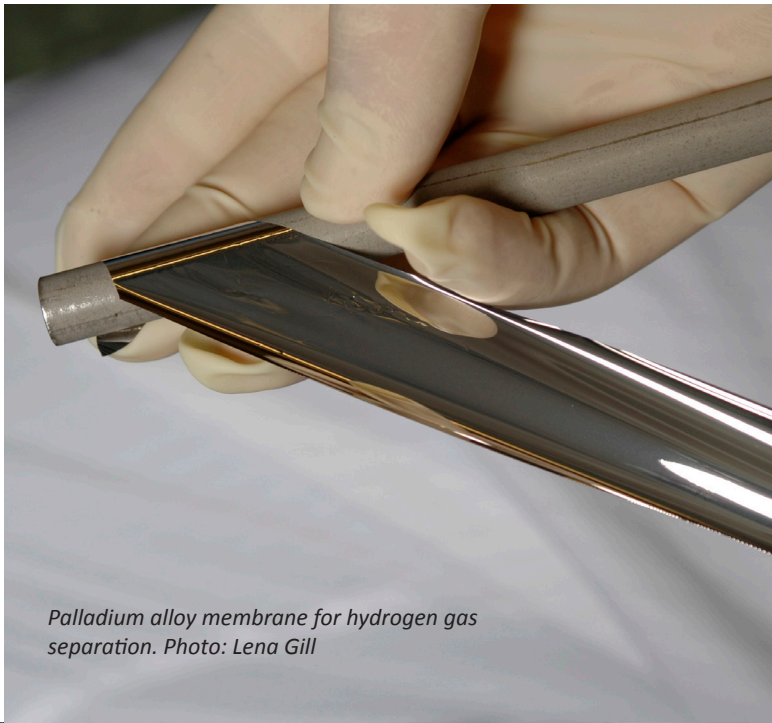
Nanotechnology for membranes

New and highly efficient separation processes are made possible by manipulating membrane materials on the nano-scale.

Applications include CO_2 capture, hydrogen production, fuel cells, gas treatment and chemical processes:

- Carbon membranes - molecular sieving
- Ionic liquid and enzyme based membranes
- Ceramic oxide membranes:
  - Oxygen and hydrogen transfer membranes
  - Dual phase membranes for CO_2 separation
- Metal membranes for hydrogen separation
- Hybrid nanoparticle-polymer membranes



Palladium alloy membrane for hydrogen gas separation. Photo: Lena Gill

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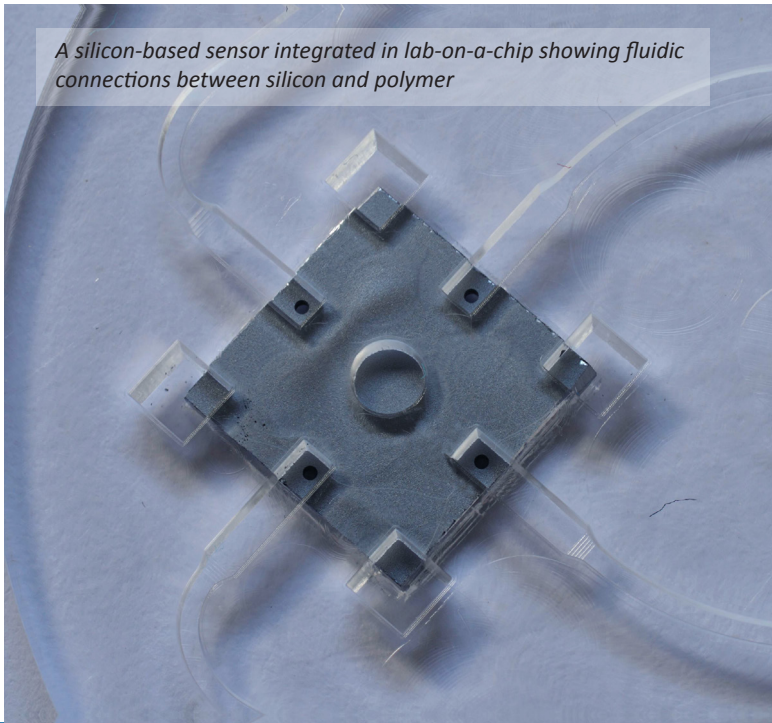
Micro and nano structured polymer components

For applications such as optics and *in vitro* medical diagnostics, low-cost high-precision components for medium to large production volumes can be realised in polymer materials, e.g. by injection moulding. Special technologies are employed to produce polymer components with nano and micro scale features in an industrial setting. SINTEF expertise in this field includes:

- Injection moulding facilities
- Competence along the chain from polymer materials to system integration and assembly, including relevant characterisation methods
- Integration of silicon chips in polymer parts, e.g. novel silicon-based sensors in polymer lab-on-a-chip, with fluidic connections between silicon and polymer



A silicon-based sensor integrated in lab-on-a-chip showing fluidic connections between silicon and polymer

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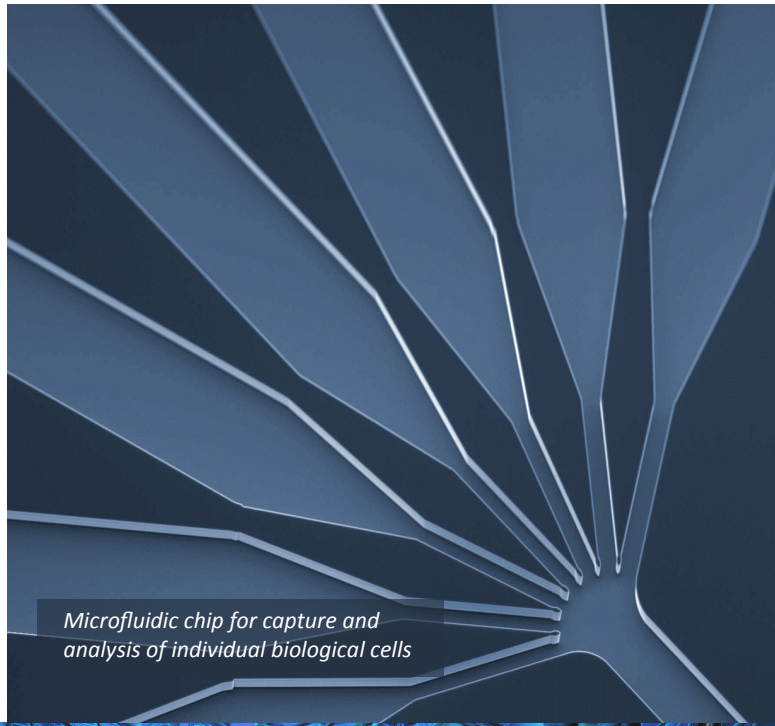
Silicon processing and device fabrication

SINTEF MiNaLab offers R&D services and manufacturing capabilities of microsystems including feasibility studies, simulation, device design, process development, prototyping and small scale production

- MEMS - Pressure and inertial sensors
- Radiation detectors - High energy physics, Material characterisation, Medical imaging and Space applications
- PiezoMEMS - Use of thin film piezomaterials and electroceramics in MEMS
- Medical Sensors and BioMEMS - Lab-on-a-Chip, Microfluidics, In vivo sensors and biocompatibility
- Micro Optics - Diffractive optical elements, Photonics, Spectrometry, Microphones, Displacement sensors



Microfluidic chip for capture and analysis of individual biological cells

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