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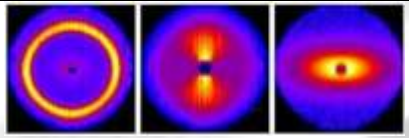
Equipment and simulation tools	
Thermodynamics: Thermal gravimetry analysis; TGA (NTNU) Differential scanning calorimetry; DSC (NTNU) Isothermal calorimetry; ITC (NTNU) Rheometry including electrorheology, magnetorheology, and in-situ small angle light scattering rheometry (NTNU) Thermal desorption spectroscopy (NTNU)	**Modelling tools**: Monte Carlo methods Algorithmic modelling Molecular dynamics simulations Continuums methods Band structure calculations Quantum methods
Sample preparation: Purification of colloids and biopolymers (NTNU) Freeze-fracture/thin film replica technique (NTNU) Thin film vacuum deposition (NTNU)	**Surface analysis**: Atomic force microscopy; AFM (IFE, NTNU) Electron spectroscopy; XPS, UPS (NTNU) Photoemission microscopy; PEEM (NTNU)
Scattering/Diffraction: Small angle neutron scattering; SANS (IFE) Liquid/amorphous neutron diffraction (IFE) Wide-angle scattering of neutrons and X-rays (IFE, NTNU) Small angle X-ray scattering; SAXS (NTNU) Low energy electron diffraction; LEED (NTNU) Dynamic and static light scattering (UiO, NTNU) Small angle light scattering (NTNU, UiO)	**Imaging**: Magneto-optical imaging (UiO) Image processing, microscopy (IFE, UiO) Ultra-fast recording equipment (UiO) IR-camera (UiO) Scanning-Hall & thermal imaging (UiO) Scanning electron microscopy; SEM (IFE) Transmission electron microscopy; TEM (NTNU)
Optical methods: Optical tweezers setup (UiO) Faraday effect characterization (UiO) Nanosecond electrical birefringence (NTNU) UV and visible spectroscopy (NTNU)	 ***Neutron scattering from nanostructured materials***

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A coordinated research team from

NTNU Det skapende universitet

UNIVERSITETET I OSLO

IFE Institutt for energiteknikk

nano@COMPLEX

nanoscience and nanotechnology :
The *COMPLEX*-project in Norway

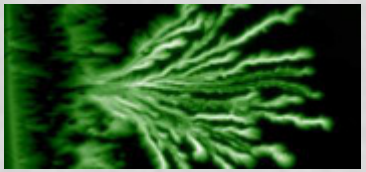
***COMPLEX* is:**

- A leading player within Norwegian nano-science and -technology
- A collaborating research team (CRT) among researchers from the University of Oslo (UiO), Institute for Energy Technology (IFE) and the Norwegian University of Science and Technology (NTNU)
- The only research group in Norway with a main focus on the nanoscale properties of soft and complex materials, which is one of the most active research fields within condensed matter physics and materials science today

Staff: (June 2006):
- 12 professors and senior scientists – all working partly or fully in nanoscience
- 17 postdocs
- 24 Ph.D. students
- 20 master students

COMPLEX CRT produced 43 articles in international scientific journals with a referee system in 2005 – 34 of those were related to nanoscience.

COMPLEX CRT has established research collaboration and networks in several countries, including France, the Netherlands, Sweden, Denmark, USA, Japan, South-Korea, Brazil, and others.



Examples of nano projects in *COMPLEX*:

Nanosilicates
Nanosilicates (clays) are layered materials where the building blocks are typically platelets of 1nm thickness. These particles may be charged, and have ions loosely attached to its surface. As a result, assemblies of such particles can organize into a variety of structures that show drastically different properties depending on external forces or applied electric fields. This may be of importance and relevance for commercial design of and production of *nanostructured passive or active smart composite materials*.

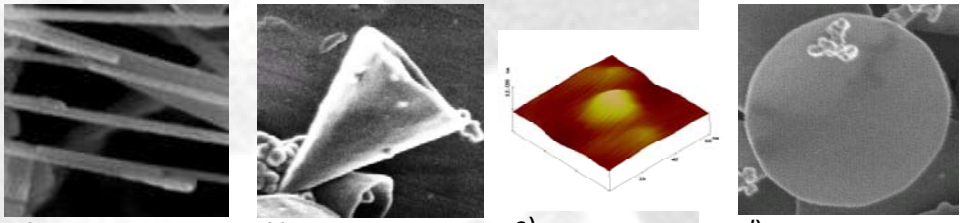
Nanocarbon
Carbon comes in various forms. the most exotic ones are the man made nanocarbon materials: nanotubes, C60 and carbon cones. These could have enormous potential for making *super strong materials, in the electronic industry and in the future hydrogen society*.

Ferrofluids
Ferrofluids are "liquid magnets" and an early success story in the commercialization of nanotechnology. They consist of a liquid suspension of magnetic nanoparticles of about 10 nm size. In the 1970s, ferrofluids were adopted by the disk drive industry as near-zero friction bearings. Prepare for a "liquid magnetism technology", with smart fluid applications ranging from *vibration shock absorption to materials separation*.

Biopolymers
The protein spectrin is our favorite model of nanoparticle of biological origin. Spectrin is a 100 nm long flexible chain made up of nearly identical 5 nm long segments. Combining experiment and theory, we investigate the *structure, dynamics and functional mechanisms of biological nanoparticles* such as spectrin.

Nanostructured surfaces
The objective of the project is to investigate changes in electronic properties of self-assembled surface alloys that are formed by annealing of thin lanthanide overlayers on transition metal substrates. The relevance of the project is towards *surface and heterogeneous catalysis*.

Complex quantum systems
Small systems are sensitive to their environment. Environment-induced non-stationary fields, i.e., noise, originating from thermal or quantum sources, are the main obstacles limiting the actual *sensitivity of nano-electronic devices*. A fundamental knowledge of how such quantum structures interact with environment is largely lacking.



a) b) c) d)

Examples of nanoparticles studied in COMPLEX projects: a) SEM image of carbon nanotubes (image width 200 nm); b) SEM image of carbon nanocone (length ≈950 nm) c) AFM image of synthetic clay nanoparticle laponite (thickness of disc 1 nm, diameter 25 nm), d) SEM image of nanocarbon disc particle (diameter ≈ 800 nm).

COMPLEX –

- Is a core partner in an EU expert network (Network-of-Excellence – NoE) INSIDE-PORES which coordinates European research on nanoporous materials
- organizes an EU innovation project (Specific Targeted Research Project – STREP) HYCONES for use of carbon nanocones for storage of hydrogen gas