

Nanotechnology at UCL

A center of innovation in Wallonia

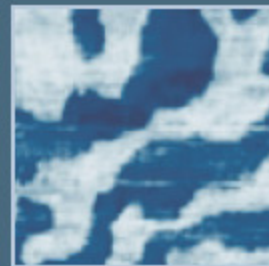
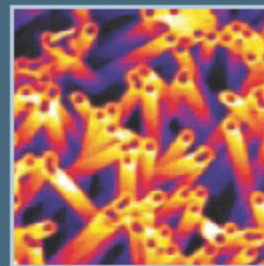
Nanotechnology

Knowledge of matter on the smallest observable scale, that is to say, a billionth of a meter, has led to the introduction of new concepts linked to the modification of certain properties of systems.

The associated fields of nanotechnology cover a set of techniques and know-how that enable today's scientists to analyze, characterize, manipulate and check objects and shapes with nanometric dimensions that offer new physical, chemical and biological properties.

At the crossroads of these various scientific disciplines nanotechnological R&D are generating rapid changes in knowledge in a host of constantly interacting sectors.

UCL offers enterprises that are ready to take up these challenges a true interface of expertise and technology that is perfectly in tune with today's industrial requirements.



CERMIN

Convergence of disciplines

Nanotechnological research at UCL is done mainly within CERMIN, Research Center in Micro and Nanoscopic Materials and Electronic Devices.

CERMIN is a network of laboratories that was set up to foster the emergence and development of nanotechnological knowledge and applications on resolutely multidisciplinary foundations.

CERMIN's strengths :

- a multidisciplinary integrated approach
- a cluster of competence and means
- leading research topics
- synergies within international networks
- access to instruments specifically designed for exploring the infinitely small dimensions

CERMIN's tasks :

- to foster the sharing of knowledge and know-how in order to accelerate and optimize the generation of new ideas
- to stimulate interactivity with industry
- to set up training schemes that meet new nanotechnological requirements

Multidisciplinary research center 140 researchers 20 academics

Nanomaterials

- Synthesis of organic and inorganic nanostructures and nanowires
- Synthesis of nanoporous membranes
- Synthesis of block copolymers and metal/ligand complexes
- Chemical phenomena in confined media
- Molecular self-assembly
- Nanomechanical characterization
- Surface characterization and nanostructuring
- Mesoscopic physics
- Nanomagnetism
- Superconducting nanostructures
- *ab initio* modeling

Nanobiotechnology

- Composition, topography and mechanical properties of biosurfaces
- Cellular adhesion
- Biomimetic biomembranes
- Biosensors
- Drug delivery
- Lipidic vesicles, lysosomes, nanosomes
- Biomaterials
- Molecular modeling

Nanoelectronics

- Electromechanical devices and microelectronic circuits
- Microwave devices and circuits
- Advanced MOS devices and quantum devices
- Spintronics
- Nanomagnetic and ballistic microwave devices

Instruments and facilities

E In addition to the usual research equipment tied to the synthesis and characterization of polymers, metals and composites (processes, determination of morphological, rheological, spectroscopic, thermal, mechanical and electronic properties, etc.), some instruments specifically designed for micro- and nanoscopic studies are available.

Fabrication and characterization of micro- and nanoscopic materials and electronic devices

E Full pilot chain for semi-conductor devices and integrated circuits : clean room, photolithography, diffusion and oxydation ovens, layer deposition (metals, alloys, dielectrics), ion implantation, wet and plasma etching

E High-resolution electron-beam nanolithography and nanoimprint

E Microscopies and surface analysis

Scanning electron microscopes (SEM and SEM-FEG) and transmission electron microscopes (TEM with X and HEELS detection)

Scanning probe microscopes (SPM) : scanning tunneling microscope (STM) and atomic force microscope (AFM) – various modes

XPS with low temperature setup

Ion spectroscopies : TOF-SIMS

E Analysis of nanostructured organic and inorganic deposited/adsorbed layers

Ellipsometry

X-ray reflectometry

Nano-indentation

E Characterization of physico-chemical surface parameters

Wetting

Surface electric charge (Zeta potential)

Bio-adhesion

E Mechanical and surface properties of solids at the micro/nanoscale

In situ nanocharacterization during traction

Nano-indentation : strain mapping

Internal stresses

E Electronic, magnetic, and thermodynamic properties

Characterization of electrical properties – low signals, low temperatures, magnetic fields, microwaves (DC-110 GHz)

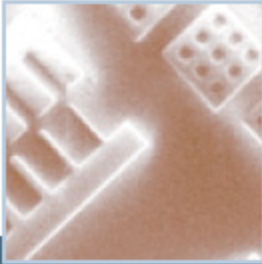
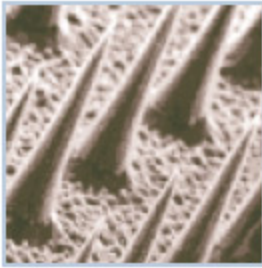
Magnetic susceptibility

Nanocalorimetry

From nanoscience to industrial development

- Knowledge of matter on the atomic and molecular scales and the ability to alter matter's composition and properties offer huge prospects when it comes to miniaturizing devices and producing new materials that can meet increasingly demanding requirements for lightness, resistance, biocompatibility, degradability and so on.

Innovation areas 	Advantages of nanotechnology 	Industries concerned
Nanomaterials <ul style="list-style-type: none"> Nanostructured polymers Polymer composites Metal alloys Catalysts Nanotubes Ceramics Self-assembled nanostructures Surface functionalisation Nanostructured reservoirs 	<ul style="list-style-type: none"> Lightness, resistance, thermal and electrical conductivity Reactivity related to the surface-to-volume ratio Controlled release Targeted surface properties Biocompatibility Self-assembly, microemulsions, encapsulation 	<ul style="list-style-type: none"> Car industry Aeronautics Polymers Textile Chemistry and materials Cosmetics Detergents Energy Powder metallurgy
Nanoelectronics <ul style="list-style-type: none"> Micro- and nanotransistors Micro- and nanoelectronic devices Fabrication of integrated circuits (photolithography, electron-beam lithography, nanoimprint) Molecular electronics Nanoelectronic devices Optoelectronics 	<ul style="list-style-type: none"> Miniaturization of sensors and electronic components Powerful, compact, energy-thrifty computers Creation of electronic/living interfaces 	<ul style="list-style-type: none"> Semiconductors Transistors Integrated circuits Microprocessors Control circuits Sensors/detectors Electromechanics Micro- and nanomotors, nanopumps, nanothrusters
Nanobiotechnology <ul style="list-style-type: none"> Chemical and biological sensors Biomimetic devices and materials Characterization of biosystems Self-assembly Drug delivery Biocompatible materials 	<ul style="list-style-type: none"> Rapid, ultrasensitive detection of proteins, toxins, viruses, bacteria, DNA fragments and various chemicals Rational drug synthesis and delivery Designing of biomaterials 	<ul style="list-style-type: none"> Pharmaceuticals Biotech Biomedical Environment



The scientific and industrial revolution triggered by nanotech research is also spilling over into broadly disseminated applications that have great economic impact and strategic added value.

Given the huge potential of such developments, many companies are already taking up this major challenge.

CERMIN

RESEARCH CENTER IN MICRO- AND NANOSCOPIC MATERIALS AND ELECTRONIC DEVICES

Connecting nano-people : <http://www.nano.be>

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The Research Administration Office of UCL stands by you

The University's Research Administration (ADRE)

informs and supports the researchers
contributes to the regional economic development by the cooperation with local firms and by its participation in technology research centers
is promoting the development of innovative products and the creation of high-tech companies in conjunction with SOPARTEC, which is UCL's industrial property manager
the university's R&D interface, INNOV-ADRE, stimulates relations between research laboratories and enterprises, facilitates technology transfer and helps to put academic's skills and competence at the forefront of industrial development.

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