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INVESTMENT AND TRADE
DEVELOPMENT AGENCY

Nanotechnology in Hungary



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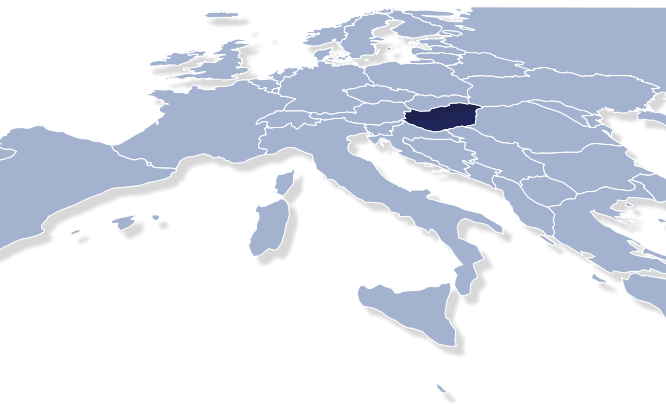
Dear Reader,

The Hungarian government has identified nanotechnology as one of the country's key innovative sectors and is supporting the field through a variety of policy measures.

This leaflet provides an overview of some of the ground-breaking research areas and globally renowned institutions in the Hungarian nanotechnology sector.

The organisations introduced here conduct cutting-edge research in nanomaterials, life sciences, laser technology and nanoelectronics and welcome all forms of partnership and co-operation.

We look forward to hearing from you should any of these exciting initiatives interest you.



Featured organisations:

Universities:

- University of Szeged, Environmental and Nanotechnology Knowledge Centre: www.szegedinnovations.com
- University of Szeged, Department of Optics and Quantum Electronics: www.opt.physx.u-szeged.hu
- University of Debrecen, Department of Solid State Physics: www.sspphys.science.unideb.hu
- University of Debrecen, Genomnanotech Knowledge Centre: www.gnd.unideb.hu
- University of Pannonia, Veszprém: www.uni-pannon.hu
- Budapest University of Technology, Department of Electronics Technology: www.ett.bme.hu
- Budapest University of Technology, Department of Electron Devices: www.eet.bme.hu
- College of Dunaújváros, Dunaújváros Regional Knowledge Centre for Materials Science and Technology: www.duratt.duf.hu
- University of Pécs, Research Section for Nanotechnology and Individual Molecular Biophysics: www.pte.hu

Institutes of the Hungarian Academy of Sciences:

- Research Institute for Technical Physics and Materials Science, Budapest: www.mfa.kfki.hu
- Research Institute for Particle and Nuclear Physics, Budapest: www.rmki.kfki.hu
- Institute of Nuclear Research, Debrecen: www.atomki.hu
- Chemical Research Centre, Budapest: www.chemres.hu
- Research Institute for Solid State Physics and Optics, Budapest: www.szfk.hu

Institutes of the Bay Zoltán Foundation for Applied Research

www.bzlogi.hu

BAY-ATI, Institute for Materials Science and Technology, Budapest **BAY-LOGI**, Institute of Logistics and Production Systems, Miskolc **BAY-NANO**, Institute for Nanotechnology, Miskolc

Companies:

- ThalesNano Ltd.: www.thalesnano.com
- Genetic Immunity Ltd.: www.geneticimmunity.hu
- Femtonics Ltd.: www.femtonics.eu
- Tactologic Ltd.: www.tactologic.com

Nanomaterials

Thin layer technologies, surfaces

Composite polymers

Ceramics

Metallurgy

University of Szeged and the Regional Environmental and Nanotechnology Knowledge Centre

Nanocomposites for industrial applications: Nanostructured materials of practical importance for medical use and catalysts of environmentally friendly fuels.

Nanostructures with photoelectric characteristics: The University elaborates novel methods of developing and fixating photocatalysts activated by solar energy and thus capable of metabolizing environmental particles.

Nanoparticles and colloid systems: Development of tunnel nanostructures made of inorganic materials; development of silver and gold colloids.

University of Debrecen, Department of Solid State Physics: multilayers, thin films and nanoparticles

- Motion and transformation of interfaces
- Thermal stability of multilayers and thin films
- Surface and grain-boundary segregation
- Morphological changes of beaded thin films

Pannonia University, Veszprém

Development of protein-based biosensors: creation of sensor proteins that are capable of recognizing target molecules and can be used to build supramolecular objects.

Research Institute for Technical Physics and Materials Science, Budapest: Complex solutions for nanotechnology: carbon nanostructures, nanoceramic composites

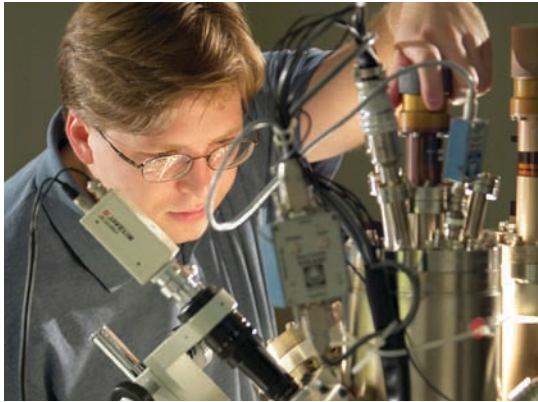
Interdisciplinary research on complex functional materials and nanometer-scale structures, exploration of physical, chemical and biological principles, their exploitation in integrated micro- and nanosystems, and in the development of characterization techniques.

The institute has almost two decades of expertise in the production and characterization of various nanostructures. In recent years its work focused on various carbon nanostructures (carbon and haecelite nanotubes, nanotube junctions, graphene and few layer graphite) their nanoarchitectures, bioinspired photonic nanoarchitectures and potential applications of these nanoobjects and nanoarchitectures in various fields of nanotechnology, nanoelectronics, sensorics and environmental protection.

The Institute is participating in several pan-European nanotechnology-related projects, such as NENAMAT, SEMI-NANO and Innovatival, and is a member of the Condensed Matter Research Centre (CMRC). CMRC is assigned the status of European Community Centre of Excellence. It is also the host of the **National Technology Platform for Integrated Micro/Nanosystems (IMNTP)**. The IMNTP is a Hungarian open multidisciplinary joint initiative for companies and institutes working on micro and nanoelectronics and photovoltaics R&D&I field (www.imntp.hu).

Research Institute for Particle and Nuclear Physics

The Institute works on the application of nuclear methods in solid state physics and materials science. Its main interest is the determination of the composition and defect structure of thin layers, defect spectroscopy of bulk solids, and clarification of local electric and magnetic structure. They study the dynamical properties of implanted systems and elementary processes of ion implantation.



Institute of Nuclear Research, Debrecen: characterisation of nanostructures

- Study of the chemical and electrical structure of surfaces and interfaces, micro- and nanolayers with Auger and photoelectron spectroscopy
- Study of the magnetic, diffusion and optical properties of nanostructured materials produced by mechanical techniques
- Study of the interaction of highly charged ions with surfaces in nano- and microcapillaries; self-organizing ion-guiding effects

Chemical Research Centre, Institute of Materials and Environmental Chemistry: new nanomaterials for applications in machine tools, plastics, medicine and environmental protection

Research in materials science aims to model chemical relationships in the composition, microstructure, properties and processing of selected structural and functional materials, as models. Models studied at the IMEC include biologically active materials, traditional and new polymers, metals, ceramics and composite materials. Outstanding results in applied research: new hip implants with increased life span developed by the Institute have already been used in the Medical School of Szeged; and applied research has begun into the use of nanopowders in medical diagnosis and environmental protection.

BAY-NANO (Institute for Nanotechnology):

Research fields include synthesis and characterisation of metallic and non-metallic nanopowders and the development of stabilised nanodispersion to create antibacterial products and catalyst particles.

BAY-NANO is also developing cutting edge technology for Severe Plastic Deformation. Within this field a commercial purity (CP) titanium and alloys of Ti are being studied. In collaboration with Admatis Ltd., BAY-NANO is developing "Shaped Metallic Foam Technology" to produce metallic foam in a specific shape.

BAY-LOGI (Institute of Logistics and Production Systems):

Inventing new porous materials and materials production technologies: the department focuses on development of cost-effective technologies, easy-to-process metal foams, foamable precursor materials and metal foam products.

BAY-ATI (Institute for Materials Science and Technology): nanopowders, nanomilling, nanolayers.

Development of soft magnetic layers for high-frequency applications; nanostructures ferrite powders produced by high energy ball milling for microwave applications.

The Foundation initiated the establishment of the Hungarian Nanotechnology Association (www.mnte.hu) which incorporates all of Hungary's major research institutes and businesses active in nanotechnology.

Dunaújváros Regional Knowledge Centre for Materials Science and Technology

The aim of the centre is to overview possible technologies to produce steels with ultra-fine grains and nanostructures as well as determining the relationship between particle size and mechanical properties. The physical simulator of the centre's Gleeble laboratory complemented by a MAXStrain unit enables ultrafine alloys with nanoparticles to be produced. The laboratory studies possible technologies to produce steels of ultra-fine structure with nanoparticles.

Health and bio

Bio/chemical sensors

Diagnostic tools

Novel biomaterials

Drug delivery and tissue engineering

University of Pécs, Research Section for Nanotechnology and Individual Molecular Biophysics

The combination of nanotechnology and biotechnology tools, the utilization of single-molecule techniques in combination with recombinant, molecular biology. The organisation explores the molecular mechanisms behind various biological processes at the single molecule level with the help of nanobiotechnology tools.

Genomnanotech Knowledge Centre, University of Debrecen: biomedical measurement method and nanotechnology

The application of the experience gathered at the University in materials science and nanotechnology for biomedical purposes.

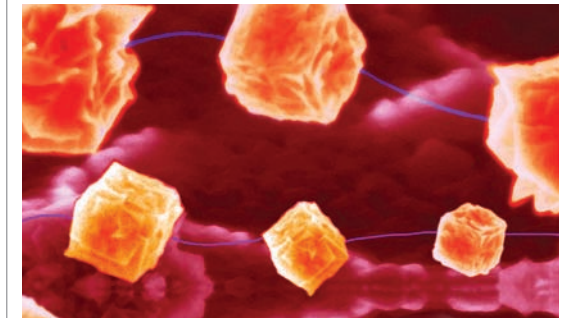
Production of nanocomposites by non-linear polymerisation, characterization of samples produced: nanocomposite hydro gels, as biocompatible and biodegradable matrices, have already been produced for dental applications.

Transformation of macromolecules of natural origin, production and characterisation of nanocomposites: production of nanoparticles for carrying active agents and DNA.

BAY-NANO (Institute for Nanotechnology): liposomal drugs, artificial blood

The Institute works towards the introduction of nanotechnology products into medical practice for the advancement of targeted nanodrugs.

BAY-NANO's first project was the development of a generic version of liposomal doxorubicin, a chemotherapeutic agent used for cancer treatment. The prototype was created and tested at BAY-LOGI. Further tests and research are currently being conducted by Richter, the largest pharmaceutical company in Hungary.



A further goal is to develop a triple module artificial blood preparation, consisting of liposome-encapsulated haemoglobin covered by a polymer.

ThalesNano's (Budapest) H-Cube®: hydrogenation of organic synthesis

The company is a world leader in the manufacture of continuous process chemistry instruments in the rapidly developing market of laboratory and process-scale-flow reactors. Its H-Cube® continuous-flow hydrogenation reactor and the pilot plant-scale version, H-Cube Midi™ have become the new industry standard for hydrogenation and are used in hundreds of laboratories on four continents.

In 2005, the company's continuous-flow hydrogenation reactor and pilot plant-scale H-Cube Midi™ won the American R&D 100 award.

Genetic Immunity Ltd.

Genetic Immunity's proprietary DermaVir Patch nanomedicine has been developed to attenuate clinical disease in HIV-infected individuals by induction of long-lasting, HIV-specific T-cells. The DermaVir nanomedicine is administered topically with DermaPrep, Genetic Immunity's proprietary transdermal vaccine delivery device. DermaPrep delivers nanomedicine through the stratum corneum into the precursors of dendritic cells, the Langerhans cells.

Genetic Immunity is a US/Hungarian development stage biopharmaceutical company establishing leadership in Nanomedicines for immune amplification. By leveraging its proprietary immune amplification platform technology, the company aims to address new markets for infectious diseases, cancer and allergies through the discovery, development and commercialisation of topically administered nanomedicines. These indications represent a significant unmet medical need with great potential for alternative treatment.

Femtonics Ltd.

Femtonics Ltd., a spin-off of the Institute of Experimental Medicine, specialises in research and development of laser scanning microscopes. The Institute's equipment is calibrated for the fastest possible 2D and 3D optical measurement, making it particularly suited to cutting-edge brain research and pharmaceutical development. The company has maintained close research contact with the Institute since its foundation in 2005. Its product line ranges from specialized products for various forms of laser scanning microscopy to the upgrade of microscope set-ups.

Laser technology

Research Institute for Solid State Physics and Optics: Development of a NANO-LDA measurement system

The main purpose of the research is to explore and extend the smallest particle size measurable with the Nanoparticle-LDA and to clarify the influence of particle structure on the measured signal. In close collaboration with SMEs in Hungary and research centres in Germany and France a prototype device is being designed to implement the experiences of the laboratory and field studies. Applications range from optimising nanoparticle synthesis with high spatial and temporal resolution through controlled formation of nanostructured films by nanoparticle deposition to contamination control in low pressure CVD processes and work-place exposure studies.



University of Szeged, Department of Optics and Quantum Electronics, Research Group on Laser Physics: laser surface engineering and thin film deposition

- basic problems of ultrashort Pulsed Laser Deposition (PLD)
- novel PLD configuration: inverse PLD (IPLD)
- PLD of boron and carbon based materials
- deposition of nanostructured thin films for sensor applications
- laser structuring of new generation solar cells

BAY-ATI (Institute for Materials Science and Technology): laser surface hardening , laser surface alloying

With partners from the University of Miskolc and two Hungarian private companies Fémalk and Silco Ltd. BAY-ATI is developing composite layer for enhancing the most exposed parts of valuable industrial tools. The novel idea is to inject additive ceramic components separately into the surface layer where the ceramic phase is being formed.



In cooperation with the Fraunhofer Institute, BAY-ATI has developed a special beam-shaping method for laser surface hardening. Applying the results of the project, several large machine parts were surface-hardened for Dunaferr, Hungary's largest foundry, and Mediagnost Ltd.

Nanoelectronics

Budapest University of Technology, Department of Electron Devices: nanostructures, integration

- Characterisation of semiconductor surfaces and very thin oxides
- Measurement of light-induced surface potential transients on Si surfaces covered by ultra-thin (tunnel) oxide
- The development of semiconductor (tin-dioxide) sensors and the investigation of nanocrystals produced by agglomeration of ultra-thin metal layers for activating semiconductor sensors



Budapest University of Technology, Department of Electronics Technology: microelectronics

The Department places special emphasis on the interconnection and packaging technology of microelectronics circuit modules and systems. Backed by a European Committee INCO-Copernicus Project and various companies and foundations from, the Department has developed a prototyping facility and processing technologies for low cost laminated multichip modules (MCM-Ls) for the benefit of small European enterprises..

TactoLogic Ltd.

TactoLogic Ltd., a spin-off of the Research Institute for Technical Physics and Material Science is the very **first manufacturer of three-axial tactile-sensor arrays worldwide**. The devices can be used for robotic, virtual reality, medical, industrial, and scientific purposes for a wide range of applications. Compared to other pressure-mapping systems, the devices measure not only one, but all three components of the contact force profile over the sensor array, with up to 64 sensor elements. TactoLogic Ltd. has been selected as the best spin-off company of the year 2008 in Hungary by Ernst and Young. The institute's most significant research area is the integration of MEMS/ NEMS and PV devices performed by its Microsystems department.



ITD Hungary - A One-Stop Shop for Business

The government's investment and trade development agency was established in 1993 to promote inward investments and bilateral trade. With representative offices in eight regional centres of Hungary and a foreign network operating under Hungary's diplomatic services and by special assignments in 60 countries, ITD Hungary is a **single point of contact** to support decision-makers looking for new business opportunities in Hungary.

The Agency's investment services include:

- In-depth, **tailored information on the local economy** and the legal environment; sector-specific overviews
- Liaising with local and central authorities, suppliers and service providers
- Information and advice on **available incentives** and finalisation of incentives agreements
- Assistance in accelerating permitting procedures, recruitment and visa procedures
- Mediation between companies operating in Hungary and the government sector to **improve the business climate**
- Support and generation of reinvestments
- Promotion of Hungarian direct investments abroad

Through a diverse set of marketing tools and support programmes, ITD Hungary offers substantial **logistical, financial and professional assistance** to both start-up and established Hungarian exporters. The Agency also co-ordinates the Hungarian activities of the Enterprise Europe Network, which, with a focus on innovative enterprises and innovation-related sectors, offers **support and advice to SMEs across Europe** and helps them make the most of opportunities in the European Union.

ITD Hungary develops and distributes **printed and electronic business literature** in a variety of languages. The Agency arranges **business programmes** for individual visitors and delegations, organises conferences, exhibitions, product showcases and other awareness and networking business events.

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