## Research Center for Microsystems and Nanotechnology (RCMN)

### Nanotechnology research centers in Lithuania, Kaunas University of Technology

The RCMN established in 1998 is focus to interdisciplinary research into microsystems and nano-instrumentation through which new ideas for improved performance based on new materials and miniatiurization may be brought into industrial practice as innovations. *The Center aims to stimulate nanoscience and microsystems technology activity in Lithuania and Baltic region by participating in European and global networks, research projects and by dissemination of information.* The Center coordinate Lithuanian Nanoscience and Nanotechnology network, National research priorities program "Functional materials and molecular mechanisms", partner of EU FP6 projects Micro-NanoSystems European Network pursuing the integration of NMS and ACC in ERA, Improving the understanding of the impact of the nanoparticles on human health and environment, NATO security programme grant "Optical nanosensors based on organic nanofibres".

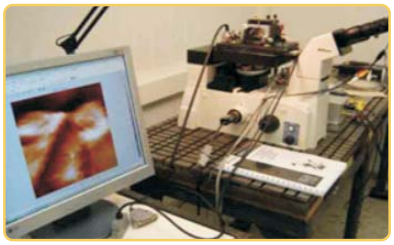
As a part of FP6 project activities Center organized the international workshop "Second MINOS-EURONET Strategy Forum for Baltic Region "Converging Technologies and Regional Competitiveness" Micro- Nano Manufacturing, Vilnius, 12-13 April, 2007 (**www.minoseuro.info**). The aim was to provoke an open debate about the future role of EU regional policy and emerging technologies in stimulating Baltic sea area innovation performance, growth and jobs and to serve as a food for thought to policy makers that they cannot blindly mimic the policies of the 'innovation hotspots' but rather need to build their own approach tailored to Baltic area potential.

**Research directions:** The RCMN anchors an efforts to investigate the behavior of single molecules and nanostructures, with an emphasis on nanomedicine, biological and materials science applications. RCMN is operated as a highly multidisciplinary facility bridging medicine, science, materials science, and engineering disciplines integrated within existing interdisciplinary campus-based and nationally and internationally networking efforts. The RCMN, located in the KTU campus, provides researchers with state-of-the-art single molecule imaging and nanoscale characterization and manipulation tools, such as multi-cell and single cell electroporation and impedance measurement instrumentation, Scanning Near Field Optical Microscopy, wide-field single molecule fluorescence microscopy and photon counting, Scanning Tunneling Microscopy, a BioAFM (combined atomic force and optical microscopy), magnetic force microscopy, Kelvin probe, SPM nanolitography, and UV-VIS spectroscopy.

***RCMN focus includes the areas of:***

**New SPM methods and development of next generation nanoscale imaging probes and instrumentation**

The center has 15 years experience in scanning probe microscopy, including STM, AFM and SNOM. In 1996 we have constructed a versatile contact/force modulation /noncontact AFM and demonstrated possibility to work on higher modes of cantilever to increase a resolution and in 2003 we have implemented an aperture-SNOM head in the illumination mode which can be operated in both transmission and reflection configurations. The photon counting module was developed and inserted in our SNOM equipment. In 2004 we developed and built the Bio-AFM with integrated flexures type XYZ positioning stage and combined with inverted Nicon-2000 optical microscope. Currently we are working on apertureless SNOM which uses AFM tips as scattering source of near field photons and possibilities to implement TERS methods into our SPM technique. We have investigated the AFM long range interaction forces between silicon tips and surfaces and we have experience on ferroelectric thin films and piezo-AFM.



*Bio AFM built at the Centre*

**Biomimetics for nanomaterials and nanosensors**

Ionic self-assembly is the coupling of structurally different building blocks by electrostatic interactions. Advantages of this method are the commercial availability of relatively cheap building blocks and the simplicity of the synthesis. Functional materials with interesting optical, electrical, magnetic, thermal, structural, or mechanical properties can be designed by a proper choice of the building blocks. We investigate the self-assembly of porphyrins in to nanotube like structures for possible application in nanosensors. The possibility to build nanotubes of different structure by ionic self-assembly of porphyrins was investigated theorethically and demonstrated . It was shown that the porphyrin nanotubes can be functionalized by metals from solution.

**Bionanotechnology and subcellular imaging:** Atomic force microscope (AFM) is the most versatile member of scanning probe microscopes family. In present it's one of a powerful tool to investigate and imaging biological structures in real time, under natural conditions with molecular, or submolecular resolution. The most serious problem to imaging biological structures is a sample preparation. We investigate the morphology of different virus like particles and it's relation with biochemical procedures and methodology of investigation. We imagine virus-like particles (VLP) and self-assembling proteins VP1 pentamers, which forms VLP. We develop the BioAFM instrumentation and investigate cells micromechanics and interaction with electric field.

*Yeast cells AFM Image*

**Collaborations:** We collaborate with partners in EU and globally. Our knowledge we disseminate teaching students at KTU and organizing with partners international PhD courses in micro-nanotechnology (www.minoseuro.info/courses.pdf). The successful collaboration with partners inside the **MINOS-EURONET** network (**NCM, Barselona**) stimulated the project proposal **"The Center of excellence in Nanomaterials"** submitted to **FP7-REGPOT 2008**. *Contacts and more information can be found at* **www.microsys.ktu.lt**.

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