

NanoHand – A System for Automated Nano-Handling – An Integrated EU Project

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In the integrated EU-project NanoHand of FP6 a nano-manipulation platform will be developed that carries out automated nano-handling of nanotubes or nanowires. Individual handling of nano-components will be addressed inside or outside of a scanning electron microscope (SEM). It is targeted to build prototypes for design and testing of future nano-devices. Together with project partners CSEM realizes a system for nano-handling under a light microscope

Nanotubes and -wires show interesting electrical, chemical and mechanical properties. Different application domains benefit from the use of nanowires, as for the following two examples: (i) Nanotubes attached to scanning tips can improve their resolution or add chemical probing sensitivity. (ii) Nanotubes integrated into novel nanoelectronic devices could improve heat dissipation or act as elements in transistors.

Handling and positioning of the nanotubes is feasible by complementary approaches: parallel catalytic growth on pre-defined positions or individual handling by single pick-and-place operations. The latter is focus of the presented work. Individual handling is essential for building prototypes of nano-devices, to achieve a high degree of flexibility and to enable quality control of devices. Nevertheless the task is complicated and lacks dedicated instruments.

NanoHand is an integrated European project run under the 6th Framework Programme [1]. It started in June 2006 and will end in May 2009. Its goal is to provide exploitable systems for nanohandling.

The project is grouped into the following sub-projects

- SP 1: Nano-manipulators and technologies (led by CSEM)
- SP 2: Applications and industrialization (led by ST)
- SP 3 and 4: Accompanying measures and management

CSEM is leading SP 1: the development and integration of sub-systems for nano-handling. A close collaboration with leading scientific and industrial partners from Europe has been established. The sub-systems for nano-manipulation consist of mobile and fixed piezo robots for precise locomotion and flexible reconfiguration (EPFL), gripping and handling strategies for reliable manipulation of nanotubes and -wires (MIC), and vision and control for stable object detection and task automation (OFFIS, CSEM). These components are integrated into a set-up that can be operated in an SEM or under a light microscope.

CSEM is developing a microscopic set-up for the automated handling of nanowires outside of the SEM (Figure 1). Nanowires are structures with lateral dimension of up to several 100 μm that can already be observed using light optics. The set-up consists of several piezo robots (cartesian x-y-z stage, mobile robots that can move and rotate on a surface, rotating stage) developed by EPFL. They carry microgrippers provided by MIC to manipulate nanowires. CSEM has integrated the various components under a light microscope (Figure 2). A modular control system has been developed that will enable automated handling based on visual servoing of the robots. In the upcoming project phase the hard- and software elements will be adapted for integration into an SEM and enable automated In-SEM nanohandling.

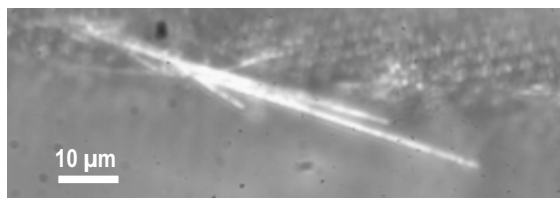


Figure 1: Silicon nanowires (diameter approx. 200 nm) under optical microscope (see Figure 1)

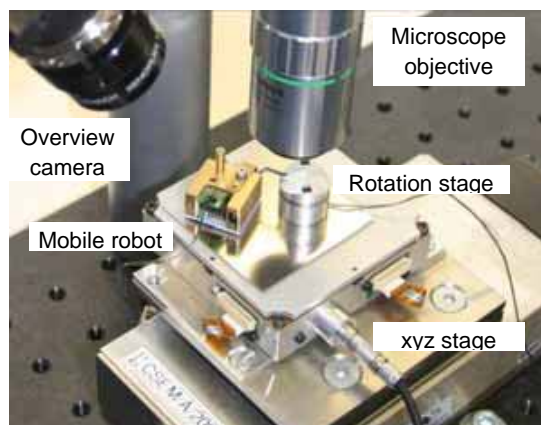


Figure 2: Nanomanipulation system under a light microscope integrated at CSEM. Sub-systems have been provided by EPFL (mobile nano-robot and rotating stage) and MIC (gripper and samples, not visible in the picture).

Project partners: CSEM, EPFL, EMPA, Eurexcel (GB), Futuretech (DE), Klocke Nanotechnik (DE), Technical University Denmark - MIC (DK), Nascatec (DE), OFFIS (DE, Coordinator), ST Microelectronics (IT), VDI VDE-IT (DE). The project is funded by the European Commission in the 6th Framework Programme (FP6-2005-IST-5, contract number 034274) and by the MCCS. Their support is gratefully acknowledged.



Figure 3: Official NanoHand logo

[1] S. Fatikow, V. Eichhorn, A. Sill, A. Steinecker, C. Meyer, L. Occhipinti, S. Fahlbusch, I. Utke, P. Bøggild, J.-M. Breguet, R. Kaufmann, M. Zadrazil, W. Barth: "NanoHand: micro-nano system for automatic handling of nano-objects", International Symposium on Optomechatronic Technologies (ISOT 2007), Lausanne, Switzerland, 8-10 October 2007