NANOIMPRINT LITHOGRAPHY:

FROM TECHNOLOGICAL EXPLORATIVE RESEARCH TO AN INDUSTRIAL TECHNOLOGY

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Recent years have seen a large interest in development of new lithographic techniques. One of these that have quickly reached a level of maturity that makes it useful for practical applications is nanoimprint lithography (NIL). This cost-efficient, high throughput method opens new avenues for nano-scale research in general and for nano-bio in particular where often a need for many samples exists in order to probe the variability that characterizes biological systems. In the first part of this paper I will discuss the development of the NIL-technology and show major characteristics of a NIL-system. Further, I will discuss the techniques pro and cons for fabrication of nanostructures. In the second part in my talk I will discuss about some applications-mainly in the nano-mechanical area. Mechanics at the nano-scale is becoming increasingly important. In this talk I will therefore highlight a number of nano-mechanical issues. I will discuss about extremely efficient nano-motors based on molecular motors derived from muscle tissue. Here we have explored various nanostructures (topographical as well as chemical) in order to guide, rectify, and direct nano-mechanical movement with uttermost precision and high efficiency. Then I will discuss about nanomechanical structures having the ability to detect few molecular reactions on its surfaces by monitoring the resulting change of resonance frequencies. The structure of the nano-mechanical device is a laterally deformable double-finger interdigitated cantilevers array (**Fig 1**), which is made on SiO_2/Si surface and evaporated with a metal layer. When a bias is applied, the cantilevers of the device will bend to each other due to electrostatic force. After deposition of a silane layer, the resonance frequency shows 25 kHz shift corresponding to a weight of 6 fg indicating that the device could be applied as a mass sensor with a 0,2 ag/Hz sensitivity. As a further extension of these nano-gratings we have employed nano-wires defined by Nanoimprint lithography and epitaxial growth. Surfaces containing such nano-wires have been used to study neuronal outgrowth, cellular response and cellular survival (**Fig 2**. We show that peripheral nerve cells can survive and grow on gallium phosphide (GaP) nano-wire surfaces and that cells are activated by the nano-topography. Then as a concluding remark, I will give an outlook and discuss about NIL´s role as a very versatile alternative for future nano-science based production.

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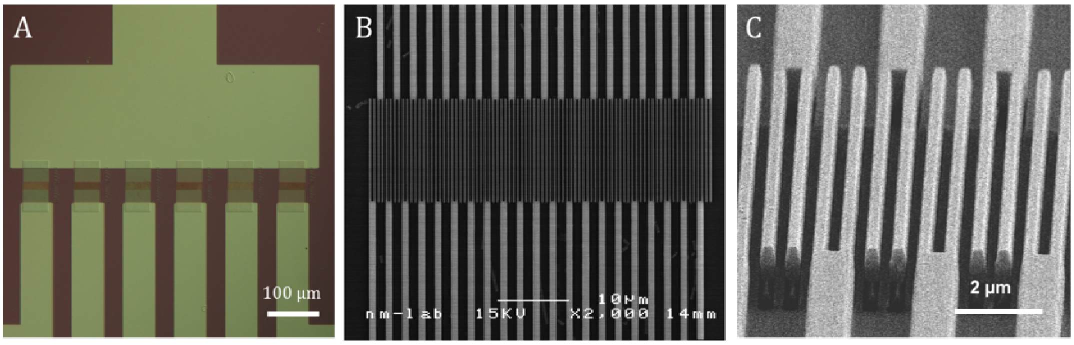

Fig. 1 (A) An optical microscope image of the device pattern;
(B) SEM image of a cantilever array; (C) Side view of the cantilevers.

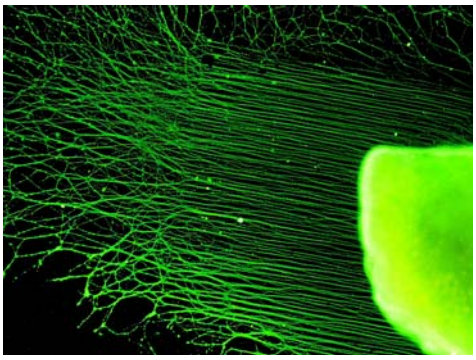

Fig. 2 a) Fluorescence microscopy image of the axons from superior cervical ganglia on a 1 by 1 mm nanowire-patterned surface (parallel rows of nanowires) b) SEM of the surface showing the aligned parallel rows of nanowires.