THREE DIMENSIONAL NANOCHANNEL NETWORKS FABRICATED WITH ION TRACK-ETCH TECHNOLOGY AND THEIR APPLICATIONS

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Large scale accelerator facilities such as the GSI Helmholtz Center for Heavy Ion Research provide unique opportunities in the field of materials science and ion-track technology using heavy ions in the MeV - GeV energy range. The interest in such beams is based on the large energy deposition along the trajectory of each individual ion creating long few nm-wide damage trails. The small diameter of ion tracks in combination with their large range (several tens of µm and more) allows us to generate nanostructures of extremely high length-to-diameter ratio and thus to overcome limits of planar structuring techniques.

The ion track technology combines ion irradiation and chemical etching where each individual ion track is converted into an open pore. Nowadays, the technique is commercially available and track-etched membranes are used as filters, cell cultivation substrates, and many other applications. Due to the excellent control of the pore diameter and shape, pore density and pore alignment, these membranes are also of great interest for the synthesis of micro- and nanowires. The membrane acts as templates for the electrodeposition of material into the pores. [1,2]

The presentation will focus on recent research developments and give a glimpse on novel possibilities based on the generation of nanowire networks. For networks, the membranes are irradiated from several directions. After track etching and electrodeposition, interconnected nanowire systems are obtained. By optimization of the fabrication processes, homogeneous, uniform nanowire networks with well controlled and systematically adjusted wire diameter, wire density and composition can be grown. Upon removal of the matrix these tailored nanowire systems are available for various scientific projects and new applications.

Figure 1 shows a representative scanning electron microscopy (SEM) image of a bismuth nanowire network together with a close-up that illustrates individual interconnections between the nanowires. Compared to arrays of parallel nanowires, the numerous junctions between adjacent nanowires in such a network renders great mechanical stability and higher electrical reliability. Samples of several cm^2 can be handled like bulk materials, while the properties of the individual nanowires are maintained. [3, 4, 5]

The latest results and emerging applications will be presented including fields such as thermoelectric sensing, transparent conductors, or selective catalysis for green fuels. [3, 4, 5]

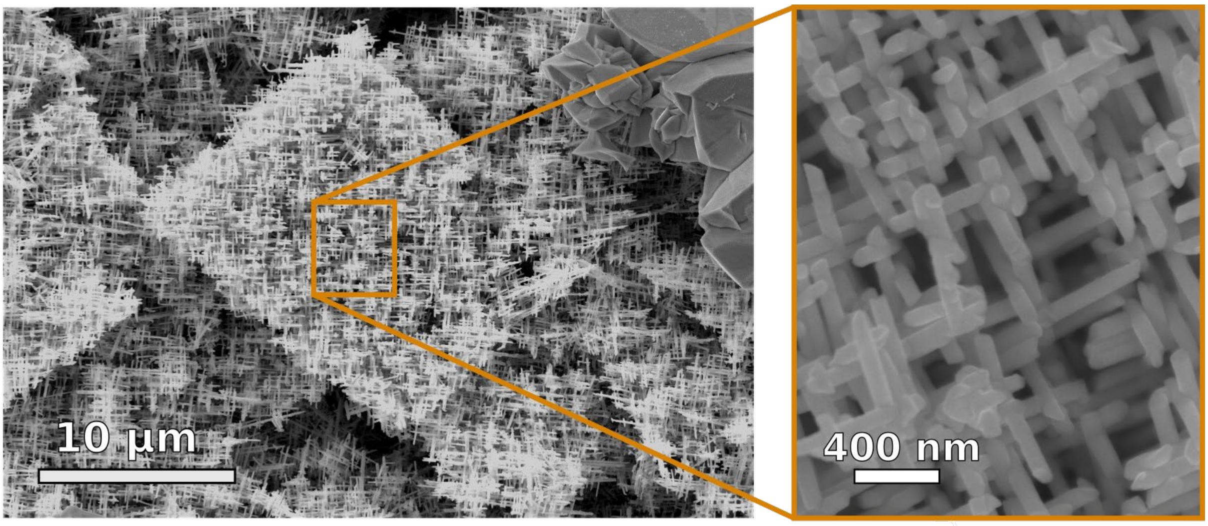

Fig. 1 SEM image of a Bi nanowire network consisting of 1.4·× 10^9 wires per cm^2 with a wire diameter of ~100 nm together with a close-up illustrating the wires interconnected within the network.

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