

## Electron Beam Induced Deposition of Iron Nanostructures

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Novel nanoelectronic approaches require perfectly aligned electrical contacts to irregularly distributed nanotubes, nanowires or DNA-molecules. Direct-write methods have the potential to close this gap. Electron beam induced chemical vapor deposition was applied for mask-less nanostructure fabrication of iron structures. This maskless technique allows to produce structures at nm-scale within a single process step.

Deposition was performed with a scanning electron microscope equipped with a self designed gas inlet nozzle system. The process is based on locally confined chemical vapor deposition (CVD). As volatile organo-metallic precursors iron penta carbonyls was introduced at a chamber pressure of  $1 \times 10^{-5}$  mbar. The iron precursor adsorbed on the surface and was decomposed by the energy of the focused electron beam. Focusing the beam on a specific spot resulted in the deposition of iron nanowires perpendicular to the surface.

The growth of nanowires was investigated and the formation of large polycrystalline structures was observed (Fig. 1). The effect of sample temperature and the results of post-deposition annealing on the deposited structures were investigated. A TEM study revealed a dendritic growth of the large polycrystalline structures (Fig. 2). The material composition was investigated by AES, EDX and effects of beam current (Fig. 3) chemical additives (such as hydrogen) on material purity were investigated. Additionally, the electrical and magnetic properties were tested by 4-point measurement, magnetic force microscopy (MFM) and SQUID measurements. The adaptation of process parameters towards high deposition yields and resulting insights on the mechanism are reported.

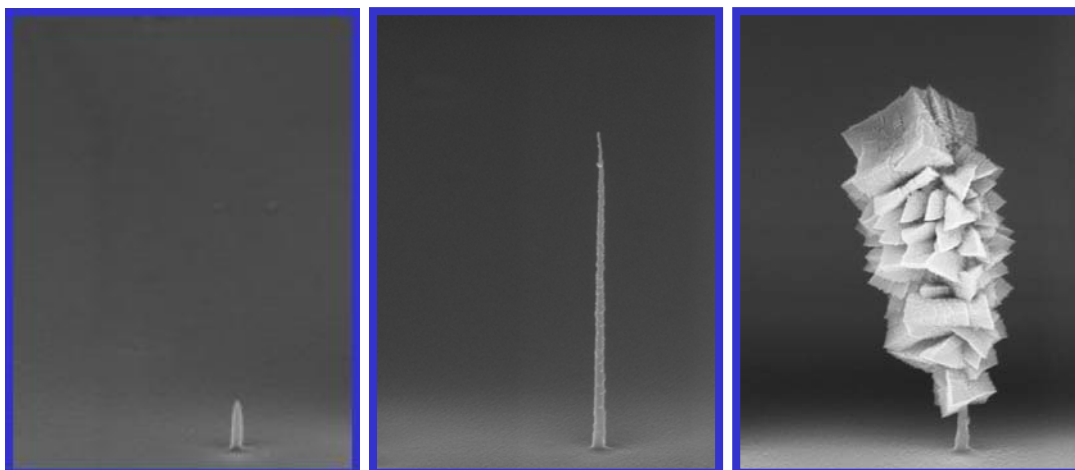


Fig. 1. Progression of nanowire growth after 10 s, after 60 s and after 90 s (Acc.volt.= 10 kV Beam current = 1.97 nA)

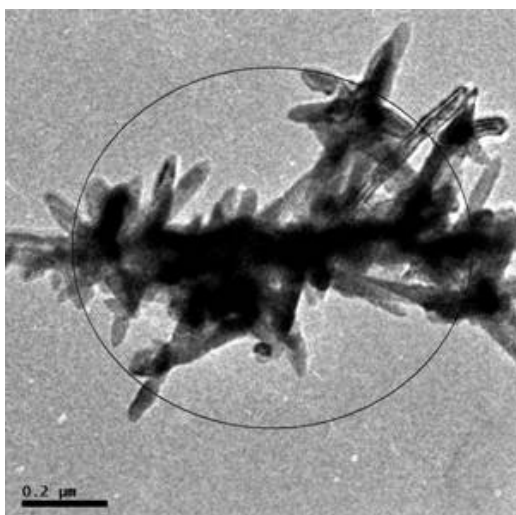


Fig. 2 TEM image - dendritic growth

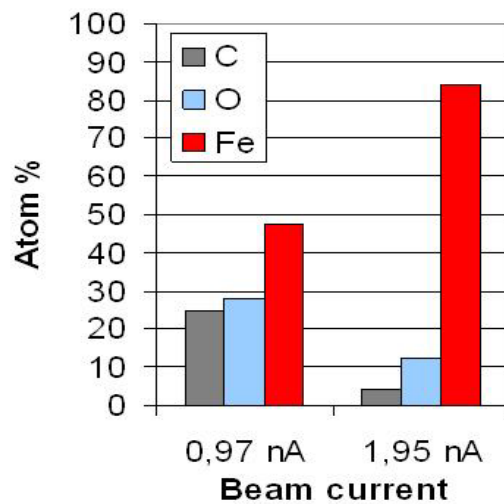


Fig. 3. EDX- chemical analysis