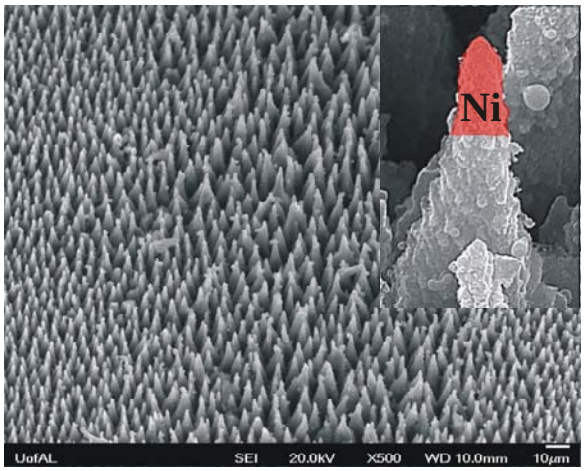

Electron Micrograph of an array of silicon nanopillars, the top of which was coated by electrodeposition with a magnetic material.

Novel Nanotip Functionalization by Electrodeposition

This work was done by Patrick McGowan at the University of Alabama in a collaboration with Barada Nayak at the University of Virginia. The idea was received at a NSF-ECCS grantee workshop this spring in Reno, NV. Barada Nayak is preparing arrays of nanopillars by laser stimulated evaporation from a uniform surface, leaving behind nanopillars the dimensions and spacing of which can be controlled by the laser parameters. This methods works for a variety of materials.
Here we used an array of nanopillars on silicon for directed electrodeposition of a ferromagnetic metal on the top of these pillars. Electrochemical Deposition, when operated under the diffusion-limited condition, is driven by the electric field which moves the cations towards the cathode. The concentration of field lines at the tips of the nanopillars directs the material this location. It is a combination of the electric field line bunching and the ion transport from the bulk of the solution which leads to accumulation almost exclusively at the apex of the tips. This results in a very localized formation of a magnetic coating. The arrangement of these nanomagnets is given by the pattern of the nanopillars. The picture shows the array of the nanopillars and, in the inset, the top of a single pillar with schematically shown the area of deposition. This is a novel and simple method for production of nanostructures allowing to combine a variety of materials. It could enable production of field emission electrodes.

This is the outcome of an interdisciplinary effort combining expertise in engineering, physics and chemistry. An undergraduate student in the EPSCoR state of Alabama carried out the work. The patent application process is initialized. It method has application potential for simplified mass fabrication of field emission tips on silicon wafers.

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