

Synthesis and Characterization of Ferromagnetic Alloy Nanowires

Dr. Saikat Talapatra

Ferromagnetic materials at the nanoscale possess unique properties compared to their bulk counterparts, due to their reduced dimensionalities. In particular, ferromagnetic alloy nanowires have potential for application in a variety of fields such as wear-resistant, corrosion resistant, and/or heat-resistant materials, microelectronics, microsystems technology used to manufacture sensors and actuators and microrelays. However, developing functional materials from these alloy nanowires for advanced applications require proper tuning of their properties through controlled synthesis strategies. In this project we will focus on the fabrication of a variety of ferromagnetic alloy nanowires with varying composition and dimensions.

One of the most elegant and cost effective techniques for achieving this purpose is to use electrodeposition (an electrochemical procedure schematically shown in figure.1.) of desired materials in nano porous templates (for example Anodized Aluminum Oxide (AAO) templates). The individual nanopores in the AAO can be ordered into a close-packed honeycomb structure and the diameter of each pore and the separation between two adjacent pores can be controlled by changing the anodization conditions. This in turn provides control over the dimensions of the nanowires (see Figure. 1.). similarly, the composition of the alloys can be controlled by varying the chemical composition of the electrolytes.

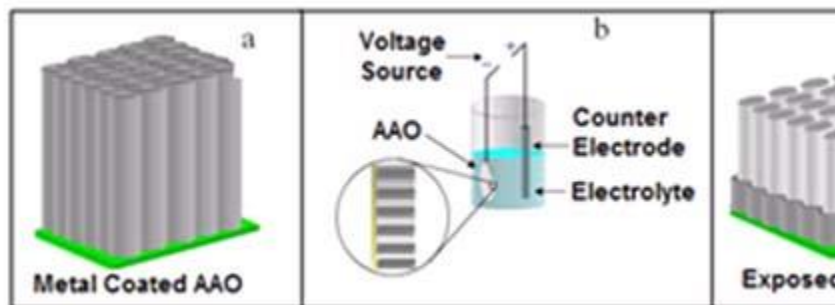
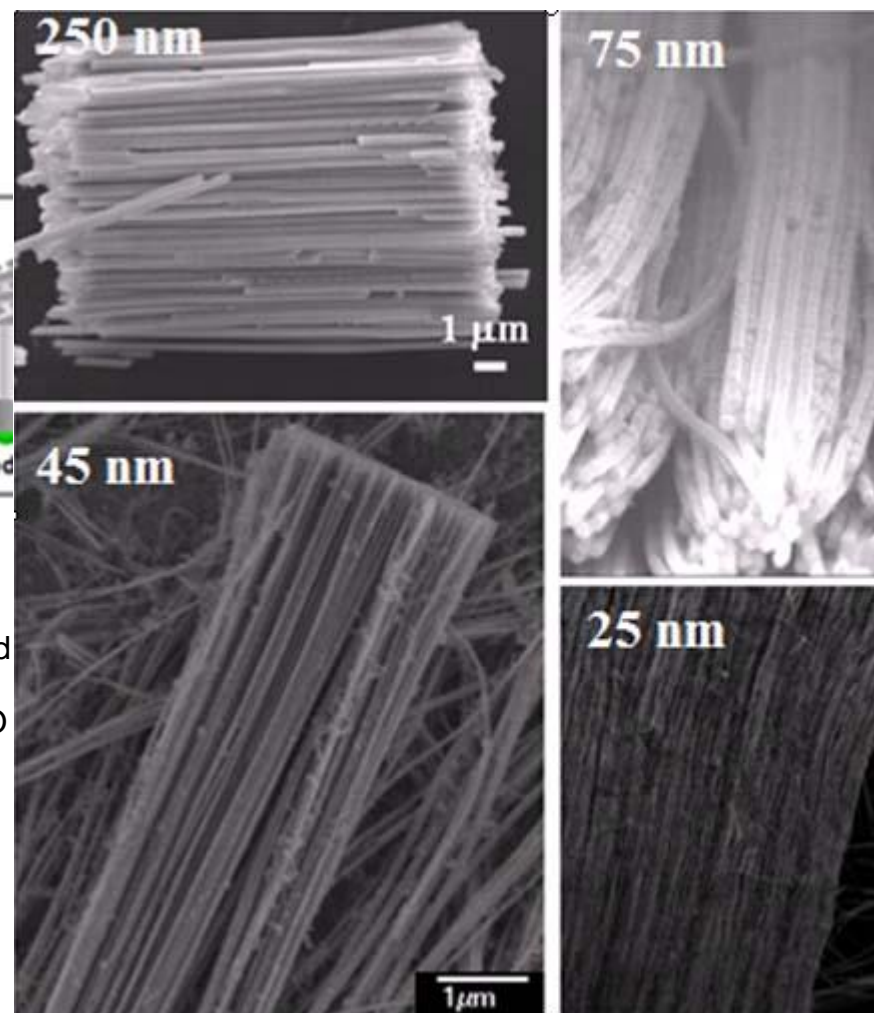


Figure 1. (Top) Schematics showing templated synthesis of nanowires. (a) A thin layer of suitable metal is electron-beam deposited on one side of the porous anodic alumina oxide (AAO) template. (b) This metal/AAO assembly is used as one of the electrodes in the electrodeposition process using a suitable electrolyte. (c) After the deposition the AAO template is etched away to expose the nanowires. (Right) Different diameter nanowires synthesized using this technique.



The REU student will participate in the synthesis and structural characterization of magnetic alloy nanowires. In the process they will learn an elegant technique for fabrication of nanowires and acquire some advanced materials characterization skills.