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Synthesis of Nanowires by Electrodeposition into Mesoporous Silica Films

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The formation of nanoparticles and nanowires with narrow size distributions is of considerable interest in many areas, but particularly for magnetic storage applications. Magnetic nanoparticles are of interest for use as the storage media in hard drives and in magnetic tape. For this application narrow particle size distribution is particularly important as this strongly effects the rate of data reading and writing. Nanowires are of interest in advanced magnetic read heads. The pore diameters of mesoporous silica synthesized from surfactant or polymer templates, typically 3-5 nm, matches current interest in industry. The narrow size distribution typically found in such materials is a particularly attractive feature.

We have been studying the problem of electrodeposition of magnetic materials into mesoporous silica films. We have determined that mesoporous silica films dip-coated onto gold substrates do not survive removal of the template. Both copper and nickel surfaces however do retain good mesoporous silica films after drying and removal of the polymer template by washing in isopropanol. X-Ray Diffraction (XRD) clearly shows the formation of mesoporous silica films, and the retention of the mesostructure after washing. There is however evidence for some shrinkage of the film, as indicated by a move to higher angle of the small angle XRD peaks. Electrodeposition of cobalt and nickel was carried out from aqueous solution. Growth of cobalt into and through the film was established by optical microscopy, and high angle XRD which showed the formation of polycrystalline cobalt. Growth of nickel through the film was established by high resolution SEM which showed the formation of Nickel mushrooms on the surface of the silica film.