Electrodeposited magnetic nanostructures for the study of spin-dependent transport phenomena

Jie Gong and Giovanni Zangari

Spin dependent transport phenomena have revolutionized magnetic recording technology in the last 20 years. The introduction of giant magnetoresistive and later of spin valve devices in fact have been instrumental in the phenomenal increase of the recording density achieved in commercial products.

More recently, novel phenomena such as tunneling and ballistic magnetoresistance as well as magnetization switching by spin-polarized currents promise both increased sensitivity in magnetic field sensors and novel methods for the control of magnetization in thin films.

A new research program has been recently undertaken to investigate these phenomena in spatially confined magnetic structures. Magnetic nanoparticles and nanowires grown in porous aluminum oxide are two systems synthesized by electrochemical processes that may be of interest in this respect. The aluminum oxide template is extremely versatile, as it can be easily synthesized in a large range of diameters (5 – 500 nm), and the conductivity at its pore bottoms can be controlled by chemical or physical means.

Recent activities include attempts to synthesize magnetic nanostructures of the type shown below, where Co nanoparticles and single crystals nanowires have been grown directly on the pore bottoms of aluminum oxide. In particular, efforts are ongoing to control the synthesis of GMR and spin valve structure inside these pores. These structures will then be used to study the size dependence of spin-dependent transport phenomena and their applicability to the fabrication of various devices.

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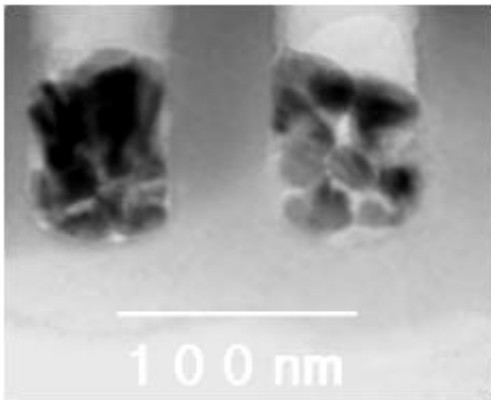

Fig.1 – Cross-sectional TEM image showing polycrystalline Co nanoparticles grown by electrodeposition into the pores of aluminum oxide.

Fig. 2 – Cross-sectional TEM image of Co nanowires in porous aluminum oxide. The nanowires are single crystalline, with defects (the oblique lines) induced by the growth process.