MAGNETIZATION REVERSAL MECHANISMS IN ELECTRODEPOSITED NANOWIRE ARRAYS

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Research in ferromagnetic nanowires is of interest from the fundamental as well as the technological point of view, due to the potential applications in magnetic recording media, magnetic sensors and biosensors.

Arrays of ferromagnetic nickel and cobalt nanowires have been fabricated by electrochemical deposition into templates with nanometer-sized pores manufactured with nuclear track etching. They display distinctive characteristics because of their one-dimensional shape and the periodic array they form.

We report on a novel method for controlling nanowire magnetic properties and growth from pore filling time profile and demonstrate the ability to fabricate very large, highly uniform arrays of Ni nanowires (15, 50, 80, 100 nm in wire diameter and 6 µm in length) with high aspect ratios (from 400:1 to 60:1). Our technique is a variant of the electrodeposition into polycarbonate nanochannels from the special time profile control technique, besides such large-scale nanowire arrays would be more difficult to produce with other techniques.

We show that stray-field presence in ferromagnetic nanowires, are entirely dependent on the nanowire diameter and observe a crossover effect in the reversal mechanism with change in diameter.

Two different types of reversal modes occur, depending on the wire diameter. For small diameter Stoner-Wohlfarth coherent rotation is expected, whereas the reversal in larger diameter wires is achieved via a space dependent radial curling mode.

We have supported our understanding of the reversal process with theoretical modelling. A marked increase in the coercive field characterizes the intermediate region between coherent rotation and magnetization curling.

The response of such a large number of almost identical nanowires will be compared to the magnetization reversal theory in isolated nanowires, and the effect of geometrical, compositional as well as inter wire interaction will be discussed.