Electrodeposited compositionally graded and diameter modulated magnetic nanowires for spintronic devices

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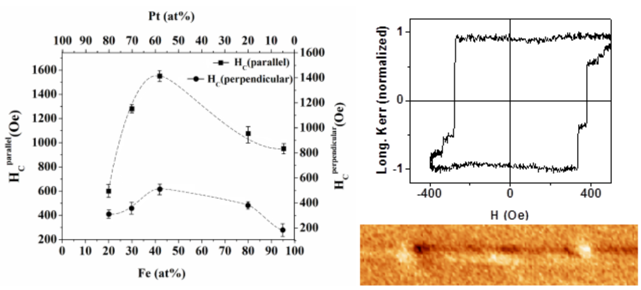
Magnetic nanowires have attracted much attention for magnetic random access memory, spin torque devices and domain-wall movement controlled based spintronic devices. Template electrodeposition is an established and widely studied method for fabricating magnetic nanowires [1]. However, the diameter [2] or compositionally [3] modulated magnetic nanowires have been more recently exploited for versatile capability in manipulating domain wall movement. Here is this talk; we present two types of the two nanowire systems including (1) compositionally-graded FePt nanowires and (2) diameter-modulated nickel nanowires. FePt compositionally graded nanowires were fabricated by alternating current (AC) electrodeposition as one-pot method into anodic aluminum oxide (AAO) templates. Nearly stoichiometric composition $Fe_{42}Pt_{58}$ was obtained at an intermediate deposition voltage of 12 V_{rms} and a frequency of 50 Hz. It is possible to tune the alloy composition via on the deposition voltage and frequency of AC wave by interplay between reduction potentials and diffusion coefficients of Fe and Pt ions. This makes FePt system able to access compositionally graded nanowires. As-deposited FePt nanowires exhibit a maximum coercivity of 1.55 kOe for nearly stoichiometric composition (Fig. 1a) which increases up to 1.81 kOe after annealing at 550 °C [4]. Diameter modulated Ni nanowires with different modulating segment sizes were electrodeposited into pulse-anodised AAO templates. Magnetisation loops of Ni nanowire arrays show significant magnetostatic interactions in the arrays. For individual Ni nanowires, the domain structure was imaged by MFM while the reversal process was determined by magneto optical Kerr effect (nano-MOKE), (Fig. 1b). The magnetization reversal reveals several switching steps most likely suggesting the existence of metastable states corresponding to their particular diameter modulation. Angular dependence of the switching fields proves different magnetization metastable states each of which requires particular reversal energy.



(a) (b)

Figure 1 (a) Dependence of coercivity values of FePt nanowires with different alloy content, (b) Magnetisation Kerr-effect hysteresis loop and MFM image at remanence of diameter modulated individual Ni nanowires

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