Electrodeposited CoPt magnetic arrays with perpendicular anisotropy

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Patterns of hard magnetic materials in the nanometer to micron scale are of interest in novel designs for magnetic recording media and for magnetic MEMS components, respectively. Two materials science challenges currently hamper further development of these systems. In the case of patterned media, subtractive etching processes are needed to define the patterns, which induce a number of defects in the pattern walls and degrade magnetic properties. In the case of magnetic MEMS, hard magnetic films with thickness of several microns may be required, and these are difficult to grow by conventional sputtering techniques.

We have developed a process and a material that overcome both problems. Electrodeposited $Co_{80}Pt_{20}$ alloys can be grown up to several microns thickness while maintaining hard magnetic properties (coercivity > 2 kOe). In addition, micron size patterns can be obtained by optical lithography and additive growth, thus allowing a better control of the magnetic properties. The figures below show a typical pattern of 2 μm diameter cylinders with a center-to-center spacing of 4 μm (Fig. 1) and the magnetic properties of these patterns (Fig. 2), showing a well defined perpendicular magnetic anisotropy.

We are currently trying to extend our process to the submicron size range, of interest for the production of patterned media, and to higher thicknesses, of interest for the fabrication of magnetic MEMS.

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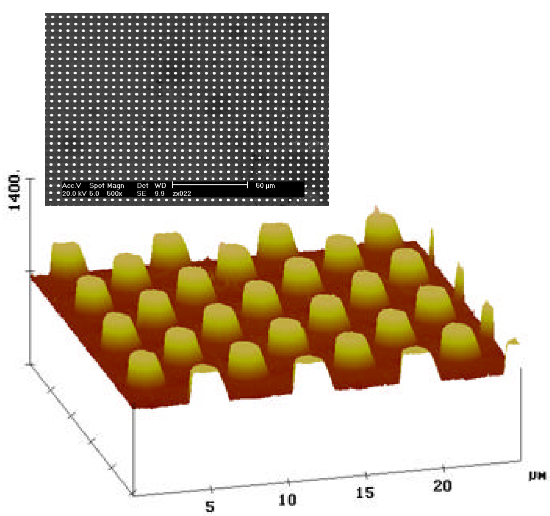

Fig. 1 – Magnetic array (2 mm diameter, 4 mm period) of CoPt cylinders, 220 nm thick. Top: SEM image; bottom: AFM image. The latter shows the flatness of the cylinders and the thickness uniformity.

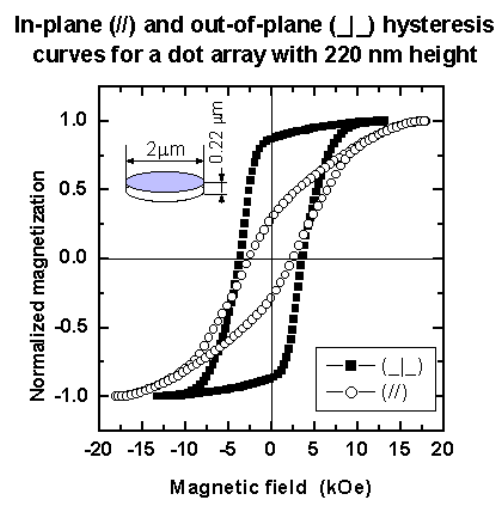

Fig. 2 – Hysteresis loops (in plane and out of plane) of the cylinders shown in Fig. 1. A net perpendicular anisotropy is observed although shape would favor in-plane anisotropy.