MAGNETIC ANISOTROPY NANOPATTERNING: A DIFFERENT WAY TO PATTERN PERPENDICULAR MAGNETIC DISK.

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Since the first commercial hard disk drive, in the 1950s, scientists have pondered the potential effects of a natural phenomenon called superparamagnetism (information is lost due to thermal fluctuations) and postulated when its presence might interfere with the industry's progress. Nowadays, we are reaching such a limit and for that reason, new magnetic storage media able to overcome that limit should be introduced [1]. In this work, it is shown that ion implantation of multilayers with perpendicular anisotropy induces modification of the magnetic properties without reduction of the total film thickness, opening the door for these new magnetic media to be applied in industrial process[2,3].

Co/Pd multilayered films ~175 Å thick with a strong perpendicular anisotropy have been prepared by means of a Circulus triatron sputtering deposition system. The samples have been irradiated with N, P and As after growth at different energies (20-30 KeV) and doses (10^{14}-$2\cdot10^{16}$ ions/cm^2). According to simulations, those values are appropriate to implant the ions at the precise depth of the Co/Pd multilayers.

Structural modifications have been studied by X-ray diffraction (XRD) and Atomic Force Microscopy (AFM). Modifications of the layer thickness are studied by X-ray Reflectrometry (XRR). Implantation effects on magnetic characteristics have been analyzed by means of extraordinary Hall Effect, magneto-optical Kerr effect and Magnetic Force Microscopy (MFM).

Figures (a) Glacing angle X-ray reflectometry of the sample as received and implanted at different doses. (b) MFM image of the magnetic domains before irradiation (c) AFM image of a thin film with a lithographic mask aimed to study the effect of localized implantation on both shape and location of magnetic domains (d) MFM image of the magnetic domains after irradiation.

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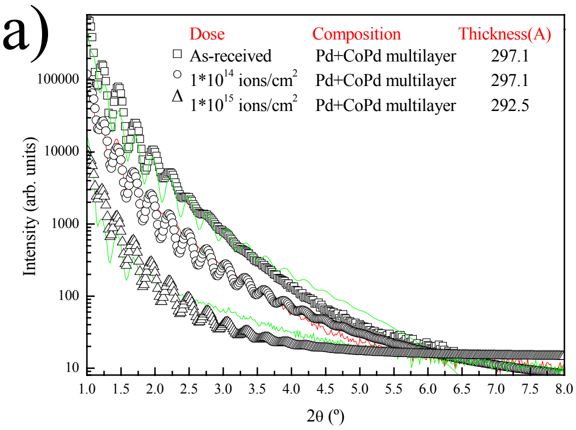
References:

[1] S. P. Li et al., Nature **415** (2002) 601.
[2] C. Chappert et al., Science **280** (1998) 1919.
[3] NanoSpain 2005

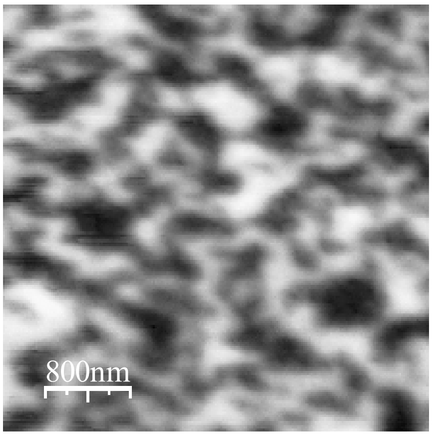
Figures:

(a)



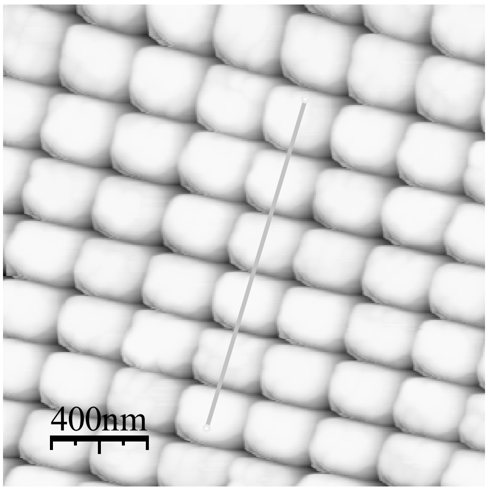
Glacing angle X-ray reflectometry of the sample as received and after implantacion with different doses. No big change in the thickness is observed.

(b)



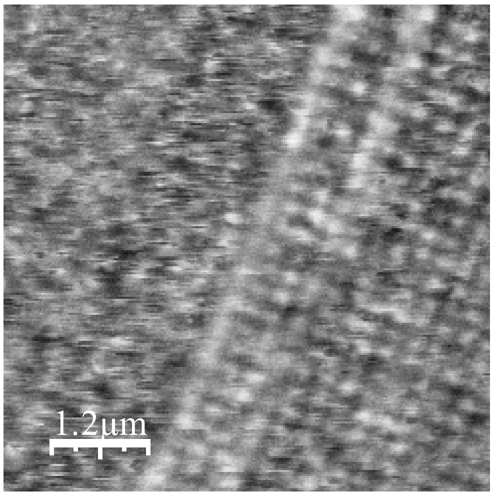
MFM Image of magnetic domains of the as-received sample in a demagnetized state

(c)



AFM image of photoresist mask with bits pattern prepared by SEM photolithography

(d)



MFM image from the edge of the nanopatterned area after $^{14}N^{+}$ implantation