MAGNETIC ANISOTROPY CHANGES OF FePt THIN FILMS INDUCED BY HIGH ENERGY ION BOMBARDMENT

M. Jaafar[(a)], *A. Asenjo*[(a)], *R. Sanz*[(a)], *J. Jensen*[(b)], *R. Schäfer*[(c)], *J.McCord*[(c)] *and M. Vázquez* [(a)]

[(a)]*Instituto de Ciencia de Materiales de Madrid, Cantoblanco, 28049 Madrid, Spain.*
[(b)]*Division of ion physics, Angstrom Laboratory, Uppsala University, Uppsala, Sweden*
[(c)]*IFW-Dresden, Desdren, Germany*
m_jaafar@icmm.csic.es

In the last years, a great effort has been done in the miniaturization of the magnetic systems. Of vital importance is to study the properties of this systems, called micro or nanomagnets because they present a novel magnetic behaviour associated to low – dimensional effects that can be used in a variety of applications such as magnetic storage, semiconductor industries, ultrasmall magnetic field sensors, etc.

In particular, in the magnetic storage, it has been necessary the development of thin multilayers, nanoparticles systems and ordered magnetic nanostrucures. Several methods have been developed to fabricate such systems, like self-organization of nanoelements [1] , electron beam lithography [2] or high energy ion irradiation [3]. The candidates to be used as materials for magnetic storage devices are FePt, FePd and CoPt alloys because they present high anisotropy and superparamagnetic limit at small dimensions.

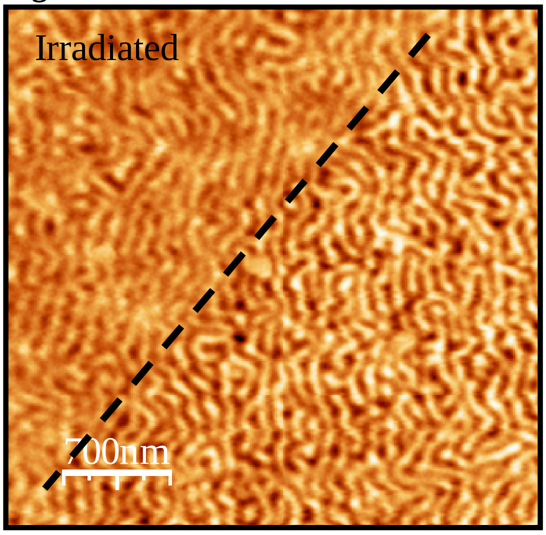
The aim of this work is study the changes in the structural and magnetic properties of the thin films due to the irradiation with high energy ions. The sample is polycrystalline FePt thin film (35nm thick) growth by sputtering onto Si (100) at 400ºC with a buffer layer of 28nm of Pt (111). From the hysteresis loops measured by VSM we know the anisotropy in mainly in plane, however, the sample presents a component out of plane.
Due to the irradiation with different ions (Br^{+} y Cl^{2+}), energies and doses, the in plane or out of plane anisotropy is favored [4]
Moreover, since the irradiation has been done through a micrometric mask we have obtain a magnetic thin film patterned at the micrometer scale.
The structural changes have been studied by X- ray diffraction and TEM (Transmission electron Microscopy).

The magnetic characterization has been done by different techniques. The volume hysteresis loops are measured by VSM (Vibrating Sample Magnetometer). In order to compare the behavior between the irradiated and no irradiated areas we use surface techniques like Magnetic Force Microscopy (MFM) and Kerr Effect Microscopy (MOKE). The MFM data are in good agreement with the VSM measurements. We can observed the out of plane component of the magnetic moment, called dense stripe domains in the non irradiated area, and different magnetic behavior in the irradiated areas as a function of the irradiation parameters. In particular, in figure 1 we can observed the same sample with two different irradiation parameters.The no- irradiated region presents dense stripe domains and the irradiated area presents in plane domains for the high dose.
We have also measured the Kerr effect in both regions. From the local hysteresis loops obtained with this technique, we note that the Hc (in plane direction) decreases due to the irradiation.
In addition, the in plane domains have been studied by Kerr effect microscope. The images are obtained applying the magnetic fields in different in plane directions (see figure 2.)

References:

[1] S. P. Ahrenkiel, S. H. Xin, P. M. Reimer, J. J. Berry, H. Luo, S. Short, M. Bode, M. Al-Jassim, J. R. Buschert and J. K. Furdyna, Phys. Rev. Lett. 75, 1586 (1995).J. Tersoff, C. Teichert, and M. G. Lagally, Phys. Rev. Lett. 76, 1675 (1996).
[2] J. F. Smyth, S. Schultz, D. R. Fredkin, D. P. Kern, S. A. Rishton, H. Schmid, M. Cali, and T. R. Koehler, J. Appl. Phys. 69, 5262 (1991)
[3] C. Chappert et al. Science 280, 1919 (1998)
[4] M. Jaafar et al. Phys. Status Solidi .Submitted for publication

Figures:



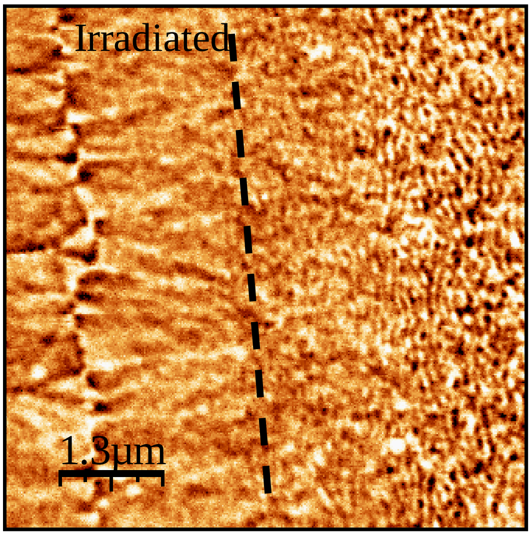


Figure 1- MFM data of the sample irradiated with Cl ions (a) $0.7 \cdot 10^{14}$ cm^{-2} and (b) $2.2 \cdot 10^{14}$ cm^{-2}

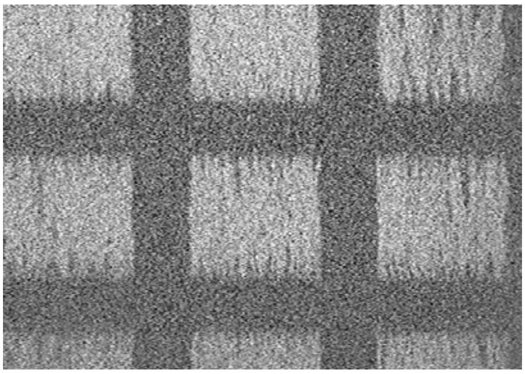


Figure 2 - Magnetic domains image by Kerr Effect Microscopy of the sample irradiated with Br ions. Image size: 170 μm x 130 μm