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Magneto-optical circular dichroism properties of fept layers with perpendicular anisotropy.

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Magneto-optical techniques allow the investigation of the reversal process in magnetic surfaces and granular systems and of their electronic structure. In the case of magnetic metals and their surfaces the use of VIS or nIR lights allow to explore the interband and intrabands transitions that involves the 3d band. Due to the magneto-optical effect is related with the spin-orbit coupling, this technique is quite sensible to structural and chemical orders which determine also the magnetic anisotropy [1]. In this work we investigate the magneto-optical properties at different wavelengths of nanometric films based in epitaxial FePt and Fe-FePt bilayer that exhibit perpendicular anisotropy. Magnetic circular dichroism technique (MCD) is used because it allows to investigate the magneto-optical properties and the reversal process of the entire layers.
FePt films of 10 nm were deposited by RF sputtering directly on a MgO (100) single-crystal in order to obtain the epitaxial growth. The growth was performed at substrate temperatures in the range 415 C and 430 C. The films were obtained by alternating the deposition of very thin Fe and Pt layers with nominal thickness of about 0.2 nm. The chosen ratio between the individual thickness corresponds to a nominal atomic composition of Fe53Pt47. The ordered L10 phase growths epitaxially [2] with the c-axis perpendicular to the substrate. Lower chemical order was observed in the film annealed at 430 C. On this film a second layer of 5 nm of Fe was deposited which constitutes the bilayer Fe-FePt.
The MCD hysteresis loops at 1.7 K were recorded using different continuous lasers covering the VIS-nIR spectrum range (476 nm - 904 nm). Details of the experimental set-up are described in [3]. The MCD hysteresis loop of the FePt film annealed at 415 C and measured with a wavelength 476.5 nm is represented in the figure 1. A square hysteresis loop is observed with a negative saturation MCD (-5.3 mrad) for positive magnetic fields. The large squareness ratio, near 1, and the large coercive field of 2.9 T confirm the high quality of the ordered c-axis epitaxial film and the orientation of the easy axis in this direction. The shape of MCD hysteresis loop measured using 632.8 nm is very similar to the measured with 476.5 nm, but the saturation MCD is positive and approximately 5 times smaller (+1.18 mrad).
In the figure 2 the MCD hysteresis of the Fe-FePt film measured with 514.5 nm, 632.8 nm and 904.0 nm are represented. The hysteresis loop measured with the blue beam exhibits positive MCD in the saturation while with the red and n-IR beams that values are negative. Moreover the absolute saturation MCD increases with the increase of the wavelength being 13.9 mrad, -20,6 mrad and –23,4 mrad for the beams with wavelength 514.5 nm, 632.8 nm and 904.0 nm, respectively. The obtained hysteresis indicate the presence of two critical field, HC1 ≈1.3 T and HC2 ≈ 0.64 T being the coercive field 0.13 T. The reversal process does not indicate a full exchange coupling between the hard and soft layers. In fact micromagnetic calculations [4] indicate that 5 nm Fe layer is a thickness for which decoupling could be possible. Finally the shape of the hysteresis loop measured with 514,5 nm is slightly different of the loops measured with largest wavelengths, which are equal. The MCD values measured with 514,5 nm in the magnetic field range between HC1 and HC2 are smaller than the measured with larger wavelength. This suggests that modification of the MO signal due to the change of the wavelength is not similar in the Fe and FePt layers.

Comparing the results, quantitatively the Fe-FePt film shows largest MCD signal than the FePt film. This difference can be due to larger Fe contain but it is not enough for explain the differences. Moreover in the Fe-FePt film the MCD changes from positive to negative values for largest wavelengths and the absolute MCD increases. The opposite behaviours are observed in the FePt film. Spectroscopic measurements are in progress to clarify these results.

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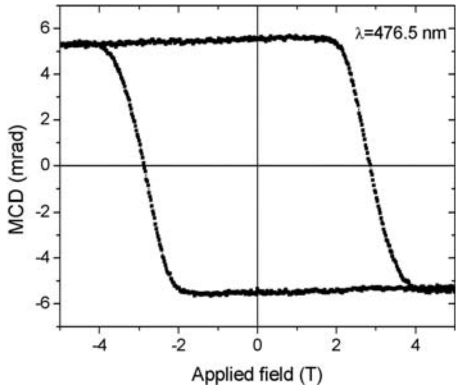
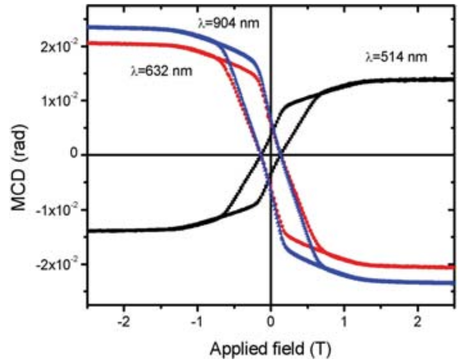


MCD hysteresis loop of the FePt film measured at 476,5 nm



MCD hysteresis loops of the Fe-FePt bilayer at different wavelegths