Magneto-optical scattering from a nano-corrugated ferromagnetic film.

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Diffracted magneto optical Kerr effect (DMOKE) is a widely used technique for investigating magnetization distributions and reversal processes in periodic arrays of micron and submicron magnetic elements **[1].** In most cases, the magnetic arrays are made of isolated magnetic entities where the magnetic interaction between them is limited to magnetic dipolar interactions. Little is known about what should be the effect on magnetic behavior of the arrays of connecting those entities.
In this work we present an approach to analyse this effect. This is done by studying the magneto-optical properties of nanocorrugated ferrromagnetic surfaces. This corrugation is achived by different fabrication methods, such as ion beam etching or standard lift-off techniques, using thick sputtered films. The fabricated etching profile is a few nanometers and can be considered as a fluctuation of the bulk dielectric tensor **[2,3].**

For a magnetic material the polarization and intensity of the scattered light depends not only on the fluctuations of the diagonal elements (topographic roughness) of the dielectric tensor, but also on the fluctuations of the non diagonal elements (magnetic roughness) and, therefore, an analysis of the different contributions, topographic vs. magnetic roughness, to the scattered light should be done before any information about the influence of corrugation on the magnetic behavior could be obtained. The measurements can be carried out in different configurations. As an example, we show in figure 1 measurements in the transversal DMOKE configuration of $\Delta I/I$ (normalized difference between intensities of p-polarized scattered light when the sample is saturated along the positive or negative direction) for different incident angles, 1.a) 60º, 1.b) 40º and 1.c) 20º, in two samples with different topography. Measuring the ratio $\Delta I/I$ function of scattering angle we can determine the difference between this two roughness, being this ratio independent of surface morphology.
The results of a theoretical model are also shown in fig.1 for two extreme cases: (dashed line) when only topographic corrugation is present, i.e., the corrugation is a magnetically dead layer, or (solid line) when both topographic and magnetic corrugations exhibit the same spatial distribution.
Two features deserve to be highlighted:
-It's demonstrated that the dependence $\Delta I/I$ vs. θ_s (scattering angle) does not depend on the corrugation periodicity, however, this ratio depends strongly on the correlation between magnetic corrugation and topographic corrugation.
-Even if no magnetic fluctuations are present, the above ratio is different from zero (scattering intensity depends linearly on the magnetization).

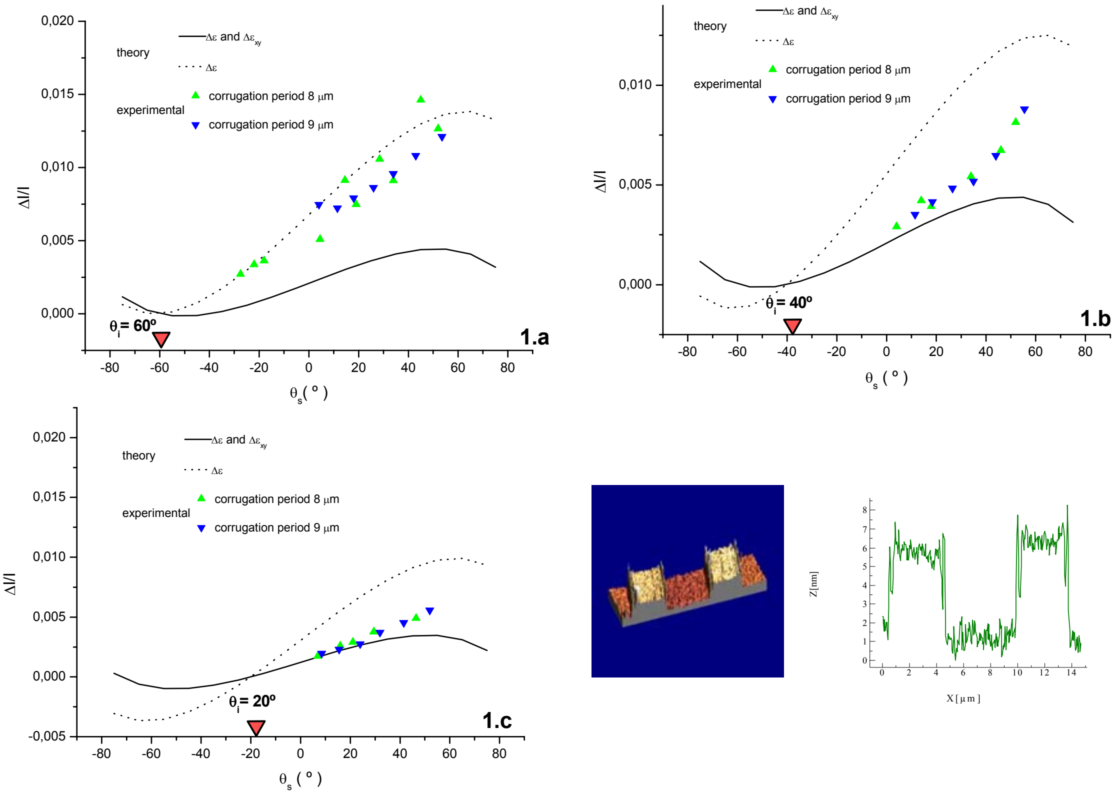

Figure. 1: Magneto-optical response ΔI/I function of θ_S for different incidence angles and different corrugation periods. Comparison between theoretical and experimental results is shown. For theoretical calculations, two cases are considered: dashed line when only topographyc fluctuation is presented (corrugation is a magnetic dead layer), and solid line when also magnetic fluctuation is located at surface. In order to compare with the perturbative theory, the corrugation must be few nanometers deep.

References:

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