Transverse magneto-optical effects in Fe antidot arrays

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During the last decade, an increasing interest has been devoted to the analysis of the interplay between plasmon resonances and magneto-optical (MO) effects [1], since the plasmon resonances can be used to enhance the MO response [2-4] and the MO effect can be used to control the plasmon propagation [5].
A great number of the studies of the MO enhancement due to plasmon excitation have been carried out in the so-called Polar Kerr configuration for MO active nanostructures (either dots or antidots) [2] or when metal nanostructures have been put into contact with continuous films of MO active material [3]. However, in the Transverse Kerr configuration the studies focus on metallic nanostructures over continuous films [4].
Here we will cover that gap and study the Transverse Kerr Magneto-Optical Effect (TMOKE) of iron hexagonally perforated films (470nm pitch, 100nm thickness and radii of 248nm and 297nm respectively). We observe a large enhancement of the TKOME signal with respect to that of the continuous film, and relate that frequencies to the possibility of surface plasmon excitations. We will also analyze their dependence on the hole radius and compare the results to a continuous iron film of same thickness.
Apart from the orientation of the magnetic field the TMOKE differs from the Polar configuration in the angle of incidence of the light beam: the Polar effect is studied at normal incidence, whereas the TMOKE needs to be off normal, since the signal is zero otherwise. This means that when the nanostructuration is realized in a periodic fashion (see Fig. 1) there is an additional parameter to take into account: the azimuth (in-plane) angle. We will thus also analyze the TMOKE enhancement as a function of the crystal orientation of the sample plane with respect to the incident light beam as shown in the experimental TMOKE spectra in Fig 1.

References:

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Figures:

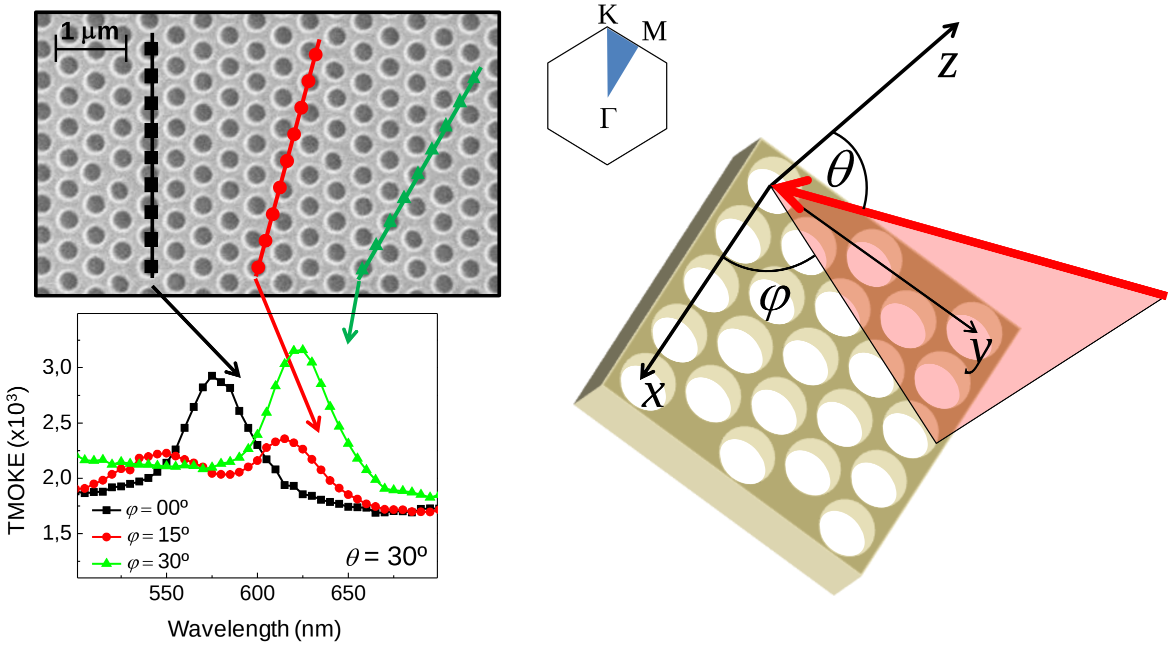

Fig. 1: Scanning Electron Micrograph of the Fe antidot array and a sketch showing the geometry and the first Brillouin zone of the in-plane lattice structure. Three characteristic TMOKE spectra obtained at different azimuth angles (θ=30 deg) showing the dependence of the TMOKE signal on the relative orientation of the impinging beam and the 2-D crystallographic high symmetry axis.