MAGNETO-OPTICAL SCANNING NEAR-FIELD MICROSCOPY

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As in other domains of physics and technology, nano-objects are becoming quite common in magnetism: dots, wires, constrictions, domains, walls … New tools have to be developed for studying such tiny objects. Besides other near-field techniques as Magnetic Force Microscopy (MFM) and Spin Polarized Scanning Tunneling Microscopy (SP-STM), Scanning Near-field Optical Microscopy (SNOM) has been applied to magnetism [1][2].
A setup able to achieve a local magnetic characterization will be presented. Together with topographic and optical images, it is possible to plot local hysteresis loops (LHL) and magneto-optical differential susceptibility (MODS) at a sub-micron scale [3]. Due to the strong correlation between the surface topography and the delivered photosignal, magnetism should be directly imaged only with a perfect flat surface. But the natural corrugation of deposited films or polished surfaces is usually not negligible at the nanometre scale. Therefore, a differential imaging process has to be chosen. The use on a non-magnetic tip avoiding disturbing tip-sample interactions, an Al coated pulled optical fiber, is one of the main advantages of the SNOM technique.
The far-field transverse magneto-optical Kerr effect (TMOKE) is sensitive to the change of the in-plane component of magnetization perpendicular to the plane of incidence. A transverse MOKE-like configuration was adopted for the near-field setup [4], allowing to plot the photosignal as a function of the applied magnetic field, i.e. the LHL. When an a.c. magnetic field is applied to the sample, it can induce local changes of the magnetization vector that can be imaged by scanning the sample. It results a map of the local differential susceptibility showing the oscillations of the domain walls and the coherent rotation of magnetization. Moreover, a d.c. field can be added showing the evolution of the domains distribution.
LHLs and images acquired on several micron size objects and comparison to far-field measurements and images will be presented.

References:

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