PROBING THE TRANSVERSAL MAGNETO-OPTICAL KERR EFFECT AT THE NANOMETRIC SCALE

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Nano-objects are becoming quite common in magnetism: dots, wires, constrictions, domains, walls…Magnetic Force Microscopy (MFM) and Spin Polarized Scanning Tunneling Microscopy (SP-STM) are currently used near-field techniques for studying such tiny objects. On the other hand, the magneto-optical Kerr effect (MOKE) is a widely used probe of magnetism in solid-sate physics. In the far-field version, the transverse configuration of the magneto-optical Kerr effect (TMOKE) is sensitive to one of the in-plane components of magnetization. Recently, a transverse MOKE-like configuration was adopted for a near-field setup [1,2].

We present a theoretical study of the transverse Kerr effect observed when an optical nanosource is scanned close to a magnetic material (within a nanometric distance). In order to achieve this task several calculations has been performed. The interaction between the nanoprobe and the magnetic structure can result in a complex electric field distribution. As a first approximation of the electric field felt by the sample we have used the expressions stemming from the Bethe and Bouwkamp theory [3]. From this field we have calculated the currents excited in the magnetic sample. The field radiated by these currents and observed in the far-field was obtained by using the electromagnetic theorem of reciprocity [3].

Some results showing the magnetic contrast for simple magnetic structures will be presented. In particular, we have studied a dot (0-D) in a single domain magnetic state and an isolated wire (1-D) containing a Bloch-type wall. The magnetic material used is $Co_{70.4}Fe_{4.6}Si_{15}B_{10}$ 60-nm thick. We will show the magnetic contrast which appears in two frequently used scanning modes: the “constant-distance” mode and the “constant-height” mode.

References:

[1] - J. Schoenmaker, A.D. Santos, Y. Souche, and L. C. Sampaio, Appl. Phys Lett, 88 (2005) 062506.

[2] - L. M. Álvarez-Prado, J. Schoenmaker, A.D. Santos, T. Fournier and Y. Souche, Phys. Stat. Sol. (a), 203 (2006) 1425.

[3] J. N. Walford, J.-A. Porto, R. Carminati, J.-J. Greffet, J. Opt. Soc. Am. A, **19** (2002) 572.