Study of Magnetic Properties on a Micromagnetic Object by Scanning Near Field Optical Microscopy

Mariana Pojar[a], Marcelo S. Lancarotte[b], Antonio Carlos Seabra[a], Antonio Domingues dos Santos[b]

[a] Laboratório de Sistemas Integráveis, Escola Politécnica da Universidade de Sâo Paulo.
[b] Laboratório de Materiais Magnéticos, Instituto de Física da Universidade de São Paulo.

Nanoscience and nanotechnology have become keywords for scientific development in most area of research, including magnetism. For this reason, there is a strong demand for tools devoted to nano-scale characterization. The Magnetooptical Scanning Near Field Optical Microscope (SNOM-MO) falls in this context due to be a technique of microscopy with high spatial resolution and magnetic sensitivity, estimated to be $\Delta M = 2 \times 10^{-12}$ emu. In contrast to traditional optical microscopes, SNOM deals with evanescent electromagnetic radiation and, consequently, the resolution is no longer limited by the Rayleigh criterion.

The SNOM-MO is a powerful tool to obtain local magnetic information through differential susceptibility and local hysteresis loops. Using this last technique, an experimental micromagnetic mapping was made for the magnetization vector on a square amorphous CoFeSiBNb object. The experimental results obtained provided information about the two chiralities existing in its closure magnetic domain structure, whose behavior is determined mainly by the shape anisotropy. The study also showed that pinnings generated by defects on surface´s object exerted great influence on the dynamic of the magnetization vectors. Due to the large amount of local magnetic information, this kind of study becomes a potential background for the development of more accurate and complete theoretical models. The experimental results demonstrate resolution better than 125 nm. This study has allowed us to access intrinsic magnetic behaviors that motivated an interesting discussion about magnetic pinnings, rotation of magnetization, reversal magnetic fields and local anisotropy.