Magnetometry

VAVASSORI PAOLO
CIC nanoGUNE and IKERBASQUE, the Basque Foundation for Science, Spain
p.vavassori@nanogune.eu

Magnetic materials are key elements of present and emerging technologies. There is a multitude of experimental techniques established, that provide insight into intrinsic and technical properties of magnetic materials. An arising challenge is the thorough analysis in order to understand the physics in a real sample and how it is influenced by material's properties like roughness, impurities or influence of the geometry. The drive to progress in measurements ultimately stems from the search for new fundamental phenomena in materials and their understanding. For example, the continuous reduction is size of magnetic structures enabled by modern nanofabrication and requested by many state-of-the-art and emerging technologies, is challenging our capability to probe and understand magnetism at increasingly smaller scales.

This lecture will provide an introduction to a number of important tools and methods employed in the investigation of intrinsic and technical properties of technologically relevant magnetic materials. They will include conventional and well established magnetometry tools and approaches available in most laboratories, like vibrating sample magnetometry (VSM), superconducting quantum interference device (SQUID), torque magnetometry, alternating gradient magnetometry, and magneto-optical Kerr effect (MOKE) magnetometries, applied to different materials, ranging from bulk magnets to thin films and multilayers as well as to nanostructures and nanoparticles [1-4]. Consideration will be also given to the special problems posed by measurements on feebly magnetic materials, like nanostructured ones, basic requirements regarding sensitivity and accuracy, and potential artifacts [5,6]. Advanced magnetometry approaches [7], including those based on large facilities tools [8,9], will be also briefly surveyed.

References

[1] Jiles D., *Introduction to Magnetism and Magnetic Materials*. London: Chapman and Hall, (1994).
[2] Zijlstra H., *Experimental Methods in magnetism*, Vol. 2. Amsterdam: North Hholland, (1987).
[3] - Fiorillo F., *Measurement and Characterization of Magnetic Materials.* Amsterdam: Elsevier-Academic Press, (2004).
[4] - Budker D. and Jackson Kimball D. F. (Eds.), *Optical Magnetometry*. Cambridge University Press (2013).
[5] – Edelstein A., *J. Phys.: Condens. Matter* **19**, 165217 (2007).
[6] - Sawicki M., Stefanowicz W., and Ney A., *Semicond. Sci. Technol.* **26**, 064006 (2011).
[7] - Pereira L. M. C., Araujo J. P., Van Bael M. J., Temst K., and Vantomme A., *J. Phys. D: Appl. Phys*. **44**, 215001 (2011).
[8] - Cheng X. M. and Keavney D. J., *Rep. Prog. Phys.* **75**, 026501 (2012).
[9] - Beaurepaire E., Bulou H., Scheurer F., and Kappler J.-P. (Eds), *Magnetism and Synchrotron Radiation*. Springer Proceedings in Physics, Vol. 133, Springer, Berlin Heidelberg (2010).