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MATERIALS, STRUCTURES, AND METHODS FOR SPINTRONIC DEVICES

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The spin-dependent electronics (spintronics) makes use of both the charge and the spin degree of freedom of electrons for preparing the next generation of electronic devices. The operation of spintronic devices is intimately related to magnetic phenomena and to the manipulation of spin-polarized currents. Nowadays, different concepts of spin-based devices are arising the enthusiasm of material scientists and microelectronics industries due to their capability in designing innovative devices for the future nanoelectronics (read heads, sensors, magnetic non-volatile memories,...). Magnetoresistance (MR) is the change of electrical resistance in materials occurring upon the application of a magnetic field and MR is an important parameter to evaluate the spin-dependent functionality of materials.[1] The engineering of thin films and multilayers has lead to the realization of devices showing large MR effects like the so-called giant-MR (GMR) spin valves and the tunnel-MR (TMR)-based magnetic tunnel junctions. In this talk, I will present the basic concepts of spintronics and MR phenomena. The high industrial interest in spintronics, motivates the development of efficient and cost-effective methods for the synthesis of thin films and structures with spin-dependent functionality. I will present the development of chemical methods (atomic layer- and chemical vapour- deposition) for the synthesis of magnetic tunnel junctions.[2] The final part of the talk will deal with the atomic-scale structural and magnetic characterization of thin films and interfaces of interest for spintronics, mainly performed by means of conversion electron Mössbauer spectroscopy.[3] Part of the research activity here presented is conducted in the framework of the SPAM[3] research project at the MDM Laboratory.[4]

[1] Mathias Getzlaff "Fundamentals of Magnetism", Springer-Verlag Berlin Heidelberg 2008.
[2] R Mantovan, A. Lamperti, M. Georgieva, G. Tallarida, and M. Fanciulli, J. Phys. D: Appl. Phys. 43, 065002 (2010).
[3] R. Mantovan, C. Wiemer, A. Lamperti, M. Georgieva, M. Fanciulli, A. Goikhman, N. Barantsev, Yu. Lebedinskii, A. Zenkevich, Hyperfine Interactions 191, 41 (2009).
[4] http://www.mdm.infm.it/SPAM3