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THIN FILMS AND NANOSTRUCTURES: THE SPIN WAVES AS A PROBE OF MAGNETIC PROPERTIES

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In the last decade potential applications in magnetic storage devices and sensors and the availability of fabrication techniques have increased the interest of the study of both static and dynamic magnetic properties of nanometer-scale-size elements. The potential for applications of arrays of single domain magnetic elements in high density, low-noise magnetic recording media and in access memory is high.
From a more fundamental point of view, the magnetic properties of such systems differ significantly from those of their bulk analogs, a phenomenon which is widely attributed to dimensional reduction. Periodic arrays of planar wires, of dots or of nanocylinders are good candidates to point out the striking physical changes induced by the reduction of the dimensionality compared to bulk material or to two-dimensional infinite layers.
The study of the high-frequency dynamic properties of such arrays using the Brillouin light scattering (BLS) technique, which gives access to the electromagnetic radiation inelastically scattered by the thermal spin waves, provides a powerful nondestructive tool allowing to derive basic information about the parameters monitoring their magnetic properties such as magnetic anisotropy contributions, size-dependent demagnetizing field, or inter-elements coupling throughout the investigation of the long-wavelength spin waves propagating in these reduced systems. The magnetic properties of such artificial structures are expected to be very different from those of a two-dimensional ferromagnetic layer because of their reduced size, of their specific shape and of their periodic arrangement. Due to the reduced size, quantization (or confinement) effects appear leading to dramatic changes of the spin wave spectrum and the spin wave density of states. In addition, dynamic excitations define the time scale of magnetization reversal process, and, therefore, they are of fundamental importance to achieve an understanding of the time structure of the reversal.
Some examples are presented and discussed to illustrate the size effects on the magnetic properties associated to the dimensional reduction.