DOMAIN WALL CONFIGURATIONS IN MULTILAYER MAGNETIC RINGS

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The physical properties of small lithographically-defined multilayered magnetic solids have recently attracted considerable fundamental and applied research. Most magnetoelectronic devices are based on bar-shaped multilayered nanomagnets, containing two magnetic layers separated by a thin layer of either a non-magnetic metal or an insulator. The resistance of such elements depends on the relative orientation between the magnetization in the free (soft) and storage (hard) layers and such structures are currently being utilized as storage cells in magnetic random access memories MRAMs). As an alternative cell shape, MRAMs based on ring-shaped multilayered magnets have been proposed. The present talk describes the different magnetic configurations available in NiFe/Cu/Co and NiFe/Cu/Co/IrMn magnetic rings with circular, elliptical and rhombic shapes. Using both four-point and Wheatstone bridge contact configurations (see Fig.1), the rings magnetoresistance was characterized and compared with that computed using a micromagnetic model. The presence of domain walls in both the soft and hard (or pinned) rings provides for a magnetization reversal dominated by magnetostatic coupling, which in turn results in each layer switching in a distinctly different manner to that observed for singlemagnetic-layer rings. The soft rings reverse from both ends by means of four 180° walls and the hard rings contain multiple 360° walls that are stable even for applied fields beyond those required for parallel alignment of the layers. Additionally, results on current-induced switching in these devices will be presented. The suitability of multilayered magnetic rings as field- and current-driven multi-bit storage cells and programmable magneto-logic gates will be assessed.

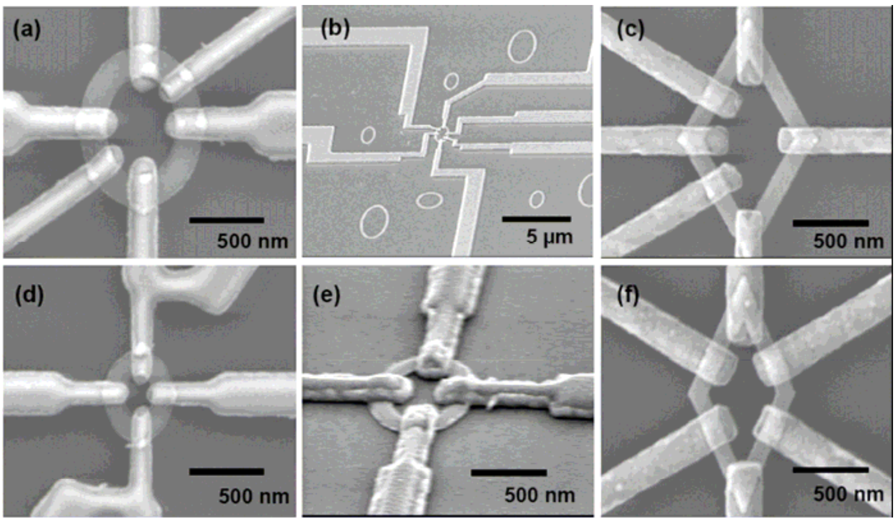

Figure 1. Plan-view and side-view scanning electron micrographs corresponding to multilayered magnetic ring devices.