Investigation of magnetic nanostructures fabricated by AFM lithography

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Here we report on fabrication and characterization of magnetic nanostructures. We will describe a lithography scheme based on the local anodic oxidation of germanium film by a scanning atomic force microscope in a humidity-controlled atmosphere. By using this technique a Ge oxide pattern is transferred to the surface and afterwards it can be selectively etched producing a mask useful for lithography. This method was used to fabricate magnetic structures in the micrometer and nanometer scale with different geometries. The basic magnetic structures investigated were metallic nanowires with rectangular cross section and thickness varying from 3.5 – 15 nm, width starting from 300 nm up to a few micrometers and length from 10 – 20 μm. By using magnetoresistance (MR) technique we were able to investigate the magnetization reversal processes that are correlated to the spatial confinement of the structures. The magnetoresistive hysteresis loops show an abrupt jump corresponding to the magnetization reversal that depends on the angle between the wire axis and the applied magnetic field direction. The field value corresponding to the abrupt jump of the MR was associated to the nucleation field deduced from the Brown equations. By the angular dependence of this magnetization reversal field we were capable to identify the nucleation mode as the magnetization buckling.