Relationship between AFM topography and magnetic properties of trench-patterned thin films

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Abstract

Current lithography techniques have allowed the fabrication of nanostructured magnetic materials in which size, shape and order have dramatic influence on their magnetic properties [1, 2]. In this work we show that the topographical characterization by atomic force microscopy (AFM) of trench-patterned thin films makes available the understanding of unusual magnetic properties. Trenched ferromagnetic nanostructures present hysteresis loops with negative remanence.

In common ferromagnetic materials, when an applied magnetic field *H* is reduced from positive saturation to zero, the remaining magnetization points also to the positive direction. It is necessary to apply an opposite magnetic field to reverse the ferromagnetic spins. In our artificially patterned thin films the remaining magnetization after removal of the external field is negative, indicating that ferromagnetic spins are inverted at positive fields. This effect strongly depends on the topography of the thin film.

A theoretical model that takes into account the AFM topography features, as width, periodicity and depth of trenches, was carried out to simulate these unconventional hysteresis loops. We obtain an excellent agreement between both theoretical and experimental results for each topographical characterization.

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References

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Figures

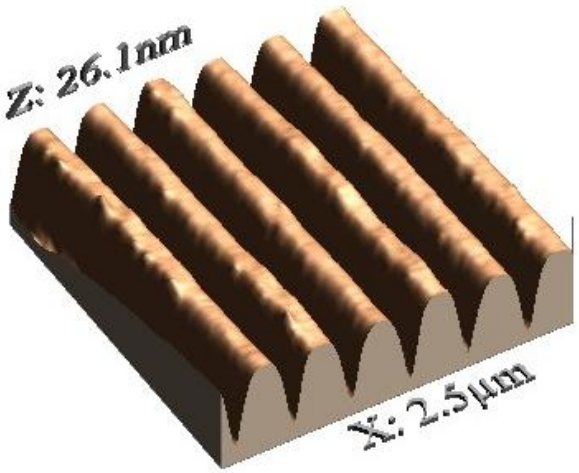

Fig. 1. AFM topography of ferromagnetic trenches of periodicity 400 nm and depth 18 nm.