

Fabrication and magnetic study in patterned magnetic nano structures

D. C. Chen*, C. Yu, S. F. Lee and Y. D. Yao

Institute of Physics, Academia Sinica, Taipei 115, Taiwan

E-mail: ydyao@phys.sinica.edu.tw

In recent years the study of the domain structures in patterned magnetic structures by Magnetic force microscopy (MFM) has attracted growing interest [1]. The MFM images of various nano-scale elements and film thickness are strongly influenced by the thickness of the films and the aspect ratio of the pattern structures. Since the MFM signal is proportional to the force gradient, which strongly correlates with the magnetic moment, MFM analysis is expected to provide quantitative data. Therefore, we can estimate the magnitude of magnetic moment in patterned magnetic structures from the phase contrast along the field direction. In this study, we present some electrical and magnetic studies in several patterned magnetic nano structures. For example, permalloy wires (400nm wide, 30nm thick, 7.5 μ m long) with different depth trenches (18,12,6nm) were fabricated by e-beam lithography and Ar ion milling. The functions of these different trenches in the wires not only can reduce the injection current but also create different pinning force for the domain wall. The MFM images show the domains of the wires were divided by the trenches and the domain walls were pinned on the trenches. A dc current from 0 to 5 mA with step 0.01mA were applied and the differential resistances (dV/dI) were measured at different external fields (H). For single domain configuration of element its phase in rectangular region show hysteresis loop with various field. In general, the switching behaviors are strongly affected by shape and size of the structures. MFM analysis is presented to support the switching processes in patterned magnetic structures.

1. Y. C. Chen, Y. D. Yao, S. F. Lee, Y. Liou, J. L. Tsai, and Y. A. Lin, *Appl. Phys. Lett.* **86**, 053111 (2005).