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Magnetization Reversal For magnetic thin Films by Pulse Fields with Duration Shorter than Relaxation Rime

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An advantage of MRAM over other memories is the possibility of high speed operation. A pulse field less than1 ns can be used for magnetization switching. Schumacher et al. found that the fieldduration along the easy axis is critical to obtain stable magnetic switching when the duration is of the order of a precessional period. Applying pulse fields with duration shorter than relaxation time,e have studied magnetization reversal for magnetic thin films by micro-magnetic simulation using OOMMF (Objective Oriented Micro-Magnetic Frame). In particular, we applied magnetic pulse fields along the easy (x-axis) and the hard (y-axis) axes at the same time. The magnetic cell was 2 nm-thick, 800 nm×300 nm $Ni_{80}Fe_{20}$. The mesh we used for the simulation was 5 nm×5 nm. We have varied the pulse fields along the easy axis from 0 to 600 Oe, and along the hard axis from 0 to 200 Oe, and pulse duration from 100 to 500 ps by 100 ps.

Our mapof the reversal switching reliability shows that the switching could be deviated much from the asteroid switching curve, depending on the pulse duration. On the increase of pulse duration, the shape of the switching map became similar to the asteroid curve. We found some unexpected area where magnetization was supposed to be reversed but it was not. Our results show that strong demagnetization along the z axis made the precession twisted, which makes possible the precessional switching not only by the perpendicular field but also by the horizontal field to the switching direction. In this presentation, we discuss the reversal switching behavior of the $Ni_{80}Fe_{20}$ thin filmunder cross pulse fields with duration of less than 1 ns.

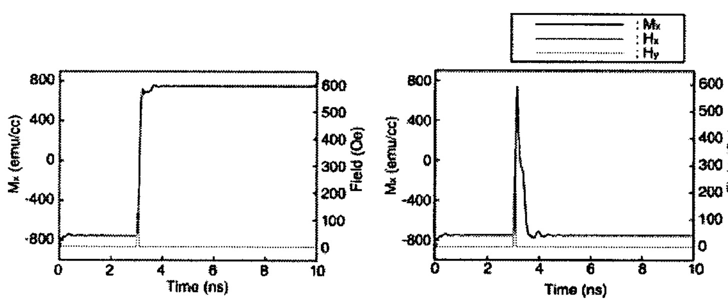

Fig. 1. Magnetization reversal behaviors with a different H_y pulse field intensity at H_x=120 Oe with duration of 100 ps. Whilethe reversal was completed at H_y=100 Oe (left), the reversal was not happened when H_y=200 Oe (right)

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FC08

Study of Spin-reorientation Transition and Magnetic Structure of Nanomaterials Using Spectro-microscopy and Spin-polarized Scanning Tunneling Microscopy

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Various magnetic imaging approaches are presented to have the excellences of electronic structure and magnetic sensitivity in nanoscaled dimension. Examples will be given, including the techniques in application of Photoemision Electron Micrscioy (PEEM) on magnetic ultrathin film, Scanning Electron Microscopy with Polarization Analysis (SEMPA) on magnetic nanoparticle assembly, and Spin Polarized Scanning Tunneling Microscopy (SP STM) on ultrathin antiferromagnetic films.

A new kind of spin reorientation transition was found in ferromagnetic /antiferromagnetic bilayer system. With increasing Mn thickness, the magnetic easy axis of 6 ML Fe/n ML Mn/$Cu_3Au(100)$ was observed to switch from in plane to perpendicular direction by magneto optical kerr effect (MOKE) and PEEM (Fig. 1). The magnetic domain of antiferromagentic Mn layer was shown to be anti parallel to the Fe domain. The perpendicular magnetization together with enhanced coercivity is supposed to be induced by exchange coupling from Fe/Mn interface. Furthermore, the magnetic layer structure of the Mn film on ferromagnetic substrate was also studied by SP STM.

Self aligned magnetic Co and Fe nanoparticle assembly, as the second example, presents an interesting magnetic domain structure. From SEMPA imagings, the domain size of nanoparticle assembly was found to be much smaller than that of ultrathin film with the same coverage. The reduced onset thickness of long range magnetic ordering and the magnetic vortex structure indicate a dipole dipole coupling under nano particles.

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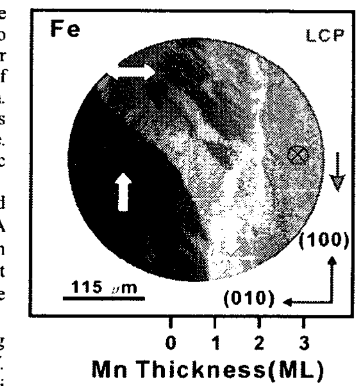

Fig. 1. PEEM imaging for 6 ML Fe/n ML Mn/$Cu_3Au(100)$ with indication of magnetization orientation.

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