Probe-based Spin Torque Transfer Device for Writing Hard Disks.

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In magnetic hard disk technology, continued scaling of bit density requires higher coercivity and anisotropy media in order to maintain data retention time. This creates a major challenge for scaling the electromagnet-based write head, which is currently being addressed by heat-assisted magnetic recording (HAMR) technology. In this work, we investigate the use of spin transfer torque point contacts induced by spin-polarized current injected from a nanoscale probe tip across a very narrow gap into magnetic media to change magnetization direction. We present our recent experiment using a functional nanoprobe to substitute the disk writer structure. State-of-the-art He-ion focused ion beam (FIB) trimming was used to develop a nanoscale magnetic structure on top of a tip as shown in Fig 1(A). The standard Ta(5nm)/CoFeB(1nm)/MgO(0.9nm) on tip side and another Ta(5nm)/CoFeB(1nm)/MgO(0.9nm) stack on media side were deposited via sputter deposition and milled. The IV characteristics are shown in Fig 1(B) and show magnetization switching of the media through MTJ-type probing. The magnetization change of practical medial structures which consist of sub-10-nm L1(0) ordered FePt structures was observed using the fixed layer of the tip as shown in Fig 1(C). This result suggests a completely new approach for hard disk writing and could pave the way to the field of magnetic recording with ultra-small, ultra-high density, and ultra-fast data rate further.

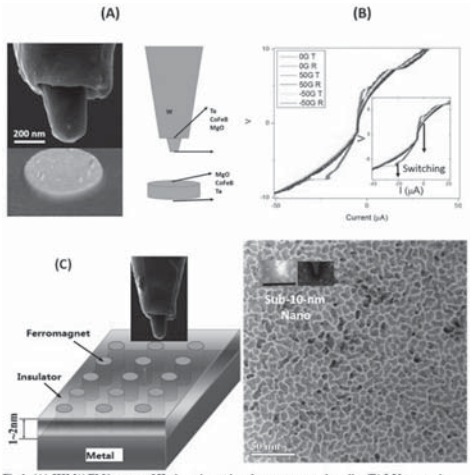

Fig 1. (A) HIM/AFM images of He-ion trimmed probe structure and media. (B) I-V curve via sweeping voltage by changing magnetic field. (C) Sub-10-nm FePt media structure. Bright and dark colors indicate two distinctive magnetization switching. The scale bar is 5 nm.

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