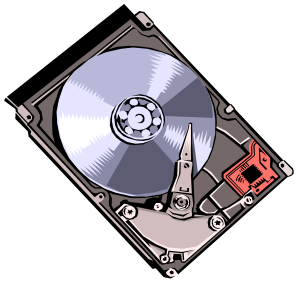
TECHNOLOGY UPDATES

EHDR HEADS:



The EHDR Heads Team had a full agenda at the recent Annual Meeting. There were seven talks, including two invited presentations from representatives of the **Data Storage Institute (DSI)** in Singapore.

Bob White (CMU) updated the status of the CPP reader program at CMU. The work is focused on fabricating a CPP-GMR reader with a [Cu/CoFe]10-sensor stack, biased by a permanent magnet located opposite the ABS side of the sensor stack. Stack MR response to date is as much as 18% at a Cu thickness of approximately 20 Angstroms, though in the finished patterned test devices it is usually more like 5%. Four test wafers, with two different stack designs, were fabricated and sent to Seagate for processing into sliders and HGA's. A key result of the test wafers themselves has been the verification that the CPP-mode GMR effect in these films is, as predicted, greater than the CIP-mode GMR by about a factor of two. A significant challenge still to overcome is the large AMR effect found in the shields that tends to obscure the GMR response of the sensors.

Jimmy Zhu (CMU) presented results of his group's modeling of a writer for 1 Tbit/in^2 recording density, with his graduate student **Daniel Bai**. The basic structure they modeled is a writer having a laminated yoke and main pole. This lamination, especially in the main pole, was found to be necessary to prevent a remanent pole when the writer width is under 100 nm. In addition, in order to achieve high field in the media it is necessary to have a very short pole length. This, in turn, results in a large magnitude of off-track field from the yoke. The media will have to have a very square MH loop with S=1.0 and nucleation field very high in order to prevent problems from this field.

Shan Wang (Stanford) presented the latest results of his work and that of **Shufeng Zhang (U. of Missouri)** on CPP-GMR stacks using nano-contact Cu inclusions to carry the CPP current. The concept is to make contact between lower and upper ferromagnetic electrodes through Cu inclusions, in the several nanometer size range, embedded in a SiC insulating matrix. Shan showed some very interesting results, verifying the ability to form Cu balls within an amorphous SiC matrix. The present work has demonstrated Cu balls of 5-10 nm diameters. In addition, they fabricated a simple spin valve structure with the Cu nano-contact material and obtained a slight GMR effect.

Jim Bain (CMU) updated his group's work on shielded, high moment writers. His particular focus was the work aimed at producing magnetically soft 2.4T CoFe through the use of a Cu seed layer. Bain's team of graduate students was able to achieve significant improvement in softness and anisotropy with about a 5Å Cu seed layer. Work is underway, as well, to understanding the changes in magnetic properties in terms of the change in stress of the films with the Cu seed, as well as other properties.

Alex Shukh (Seagate) presented results from his modeling work on the effects of write field gradient in perpendicular recording. He compared the writing effectiveness of a standard trailing single pole type writer (TP) with that of a shielded leading pole writer (LP). Alex found that the LP writer exhibits higher write field gradient than the TP writer,

has lower sensitivity of the field gradient to write current and provides sharper transitions in the media. As expected, the LP writer exhibits higher write field gradient H_{PERP}/dx over the entire range of currents modeled. It seems to provide superior results in terms of transition sharpness, SNR, and side-writing effects, compared to the TP writer.

Two speakers from the **Data Storage Institute in Singapore** gave specially invited talks. **YiHong Wu (DSI)** presented results of extensive experimental comparisons of CIP and CPP reader sensors containing nano-oxide specular layers. As found by others, nano-oxide at both the bottom and top of the active layers increases the specularity of electrons at the metal/oxide interface. Nano-oxide below the active layers also smoothes the surface of the metallic layers both underneath and on top of the oxide layer; this smoothing effect is ultimately limited by the grain size of the metallic layers as well as the initial roughness of the substrate. In the CPP work, he proposed a sensor called a Bragg Reflector spin valve. In this concept, the polarization ? in the ferromagnetic layers is increased by using an electron Bragg reflector consisting of quarter-wavelength layers of ferromagnetic and nonmagnetic structures. Experiments have been carried out to verify the concepts. Fairly large changes in the sheet resistance have been obtained.

Mansoor Jalil (DSI) discussed simulation work on the magneto-transport of granular nano-magnetic structures and possible applications to read sensors. The physics is rather complicated, and involves the transport of current from one electrode to another through an insulating layer that contains a discontinuous set of conducting inclusions. The transport is by tunneling, and involves Coulomb charging effects and spin-dependent tunneling. One very interesting and significant result of this work is that the contacts on either side of the barrier need not be ferromagnetic in order for magnetoresistance to be observed. Non-magnetic contacts do, however, increase the temperature dependence of the magnetoresistance.

~Ed Murdock, Seagate