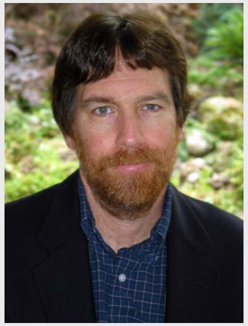
CA01

Patterned Nanomagnetic Bits and Devices

Bruce D. Terris*
Hitachi Global Storage Technologies

As conventional magnetic recording technology extends to ever higher areal density, it is possible the often predicted, and constantly increasing, density limit will be reached. This limit will likely be in the range of 750-1000 Gb/in^2. The use of nanofabrication to create patterned magnetic elements, or patterned media, is one of the proposed approaches with the promise of delaying the onset of superparamagnetism and thus enabling higher areal density. I will discuss many of the challenges that must be overcome for patterned media to be successful, including fundamental physics and material science issues, new fabrication technologies, nm-scale manufacturing tolerances, and low cost budgets.

One of these challenges is to controllably reverse one magnetic element, or bit, without affecting the neighboring elements. A narrow anisotropy distribution will be required, yet data suggest that as the element size shrinks, the distribution widens. This distribution arises from a number of sources, including shape and size distributions, edge effects, variations in the full film anisotropy and magnetostatic fields from neighboring elements. As will be discussed, understanding and controlling the switching properties of magnetic nanostructures is critical not only for patterned media, but for device applications such as MRAM cells and spintronic devices and, for current induced as well as field induced reversal.



Bruce D. Terris received the B.S. degree in applied physics from Columbia University and the M.S. and Ph. D. degrees in physics from the University of Illinois at Urbana-Champaign. After receiving his doctorate, he was a post-doctoral fellow for two years at Argonne National Laboratory. In 1985, he joined IBM as a Research Staff Member at the Almaden Research Center, San Jose, CA, and subsequently joined Hitachi GST when it was founded in 2003 and where he is currently the manager of Nanostructures group. His research interests have included thin film superconductivity and magnetism, contact electrification of insulators, and new types of scanning probe microscopes (STM, AFM, near-field optical, etc.). His current research is on nanoscale patterning of magnetic structures, thermally assisted magnetic recording, novel approaches to high density data storage and spin torque devices. He has co-authored over 90 refereed publications and been issued more than 20 US patents. He has recently served as program co-chair for Intermag 2006 and program chair for the Nanoscale Science and Technology Division of AVS for 2005. He currently serves on the Administrative Committees of the IEEE Magnetic Society and the MMM conference and will serve as US program chair for Intermag 2008 and US Conference Chair for Intermag 2011 (Taipei). He is a Fellow of the APS and AVS, and is a member of IEEE.

Contact: Dr. Bruce D. Terris, Hitachi Global Storage Technologies, San Jose Research Center, 3403 Yerba Buena Road, San Jose, CA 95135, USA; telephone +1 408 717 5262; Fax:+1 408 717 9065; e-mail: Bruce.TTerris@ieee.org

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CA02

Switching Field Distribution of Arrays of Co-Pt Nanodots Determined by Anomalous Hall Effect Measurements

M. Delalande*, J.B.C. Engelen, A.J. le Fèbre, L. Abelmann, and J.C. Lodder

Research Institute MESA+ and Impact
University of Twente, The Netherlands

*Corresponding author: Michael Delalande, e-mail: M.Y.Delalande@utwente.nl

Anomalous Hall Effect (AHE) measurements have previously been used to measure the magnetization of L1$_0$-FePt [1] and Co/Pt multilayer nanodots [2]. The high sensitivity allows us to measure the magnetization reversal behaviour of sub-100-nm dots. In this work, we investigate the magnetization reversal of 180nm $Co_{80}Pt_{20}$ dots, with a focus on the switching field distribution (SFD) of individual dots in an array. Fig. 1 shows hysteresis curves of an array of $Co_{80}Pt_{20}$ dots measured by AHE. Several steps and plateaus, due to the independent reversal of individual dots, are clearly visible. By consecutively measuring several hysteresis curves, one can observe different switching field values for a single dot (inset Fig. 1). A mathematical model was derived to calculate the effect of thermal activation on this SFD, which depends mainly on the anisotropy, switching volume and the magnetization reversal mechanism of the dot. The SFD was determined from 1000 curves and coincides with the modelled distribution (Fig. 2). By investigating different dots in the array, we conclude that there is a difference in reversal mechanism between weak and strong dots in the array.

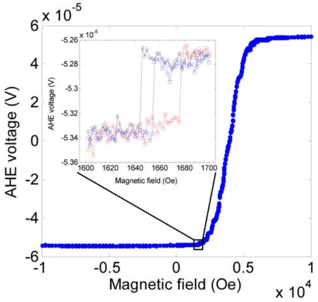

Fig. 1. Three AHE curves of a $Co_{80}Pt_{20}$dot array. The inset shows a magnification of the magnetization reversal of the first dot.

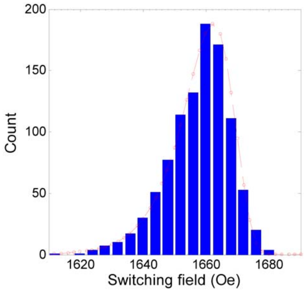

Fig. 2. SFD of a single $Co_{80}Pt_{20}$ dot from 1000 measurements. The line shows the model's best fit to the measured data.

REFERENCES

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