Magnetic Interfaces and Nanostructures
Room Exhibit Hall C & D - Session MI-TuP
Poster Session

MI-TuP1 Magnetic Properties of Ultrathin Co Films on Si(111)*, H. Xu,*
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The growth and magnetic behaviour of ultrathin cobalt films on clean(7x7) and Au covered Si(111) were investigated. All experiments including molecular beam epitaxy (MBE) were performed in an ultra-high vacuum (UHV) chamber with a background pressure of 5x10@super-11@ mbar. The Si substrates were introduced via a load-lock and firstly outgassed over night, then the substrates were further cleaned by flashing to 1500K by resistive heating for several seconds. The UHV system was equipped with Auger electron spectroscopy (AES), scanning tunneling microscopy (STM), low energy electron diffraction (LEED) and magneto-optic Kerr effect (MOKE). The growth process was studied using STM and LEED. Magnetic properties were determined with MOKE. It was found that Co nucleates in the initial stage that prefer to grow along the bunched step-edges of the Si substrate(), which leads to a strong in-plane uniaxial anisotropy (hard axis along<-110> direction). By introducing Au buffer layers, the tendency for step decoration is reduced, Co grains begin to coalesce on the terrace, so that in-plane uniaxial anisotropy is reduced. However, the magnetic characteristics were improved by the deposition of a Au buffer layer, which partially blocks the silicide reaction between Si and Co. The ferromagnetic inactive layer was found to be decreased to 2.2 ML. By using an higher flashing current, unbunched steps are created on same Si substrate. It is suggested that in this way much more regions for reaction between Si and Co grains arise and a larger amount of CoSi@sub2@ is formed which then deteriorate the magnetic properties of the film in initial layers. Furthermore, in terms of Néel domain wall model and microstructure, different dependencies of coercivity vs. film thickness were discussed.

MI-TuP2 Model Based Design of Next Generation Ion Beam Deposition Systems*, H.N.G. Wadley,*
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Ion beam deposition (IBD) is increasingly used for the growth of giant magnetoresistive (GMR) multilayers and magnetic tunnel junction (MTJ) devices. The performance of both device types is a very sensitive function of the layer thickness, the metal atom deposition rate, incident angle and energy, together with the reflected neutral flux and energy at the substrate. These in turn depend upon the ion gun, target, substrate geometry, the ion gun voltage, the ion type, the extent of target dither and substrate rotation, the background pressure, and any shaping of the metal flux. Optimally selecting these parameters for the three or more metal targets in the deposition system has become very challenging to IBD tool designers. A Multiscale model has been used to simulate the Ion Assisted Ion Beam Deposition of GMR structure. The model allows the thickness of a metal layer and the metal atom incident angle over the surface of a wafer to be optimized by selection of the ion type and energy, target placement, orientation and dither, substrate placement and rotation, and background pressure. A molecular dynamics approach based on embedded atom method potentials is used to investigate the effects of process parameters such as assisting ion energy on the interfacial roughness and the interlayer mixing during the deposition of giant magnetoresistive (GMR) multilayers. The atomic scale mechanisms of mixing and roughening at the various interfaces are identified. This simulation can then be used to identify improved deposition systems that can meet the film thickness uniformity, interface morphology and atomic scale structure, target needed for the high yield manufacture of GMR devices.

MI-TuP3 Preparation of Cross-sectional TEM Specimens of Obliquely Deposited Magnetic Thin Films on a Flexible Tape*, E.G. Keim,*
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Specimen preparation is an essential part of Transmission Electron Microscopy (TEM). In general, if one is interested in interface and/or film properties one should prepare a TEM specimen in cross-section. Upon surveying the literature, no recipe is provided for the preparation of TEM cross-sections of Metal Sputtered (MS) or Metal Evaporated (ME) magnetic thin films on polymer substrates. Various private communications in the field@footnote 1,2@ reinforce our impression that no adequate preparation procedure for this class of materials is available at present, although proper quality TEM images of ME tapes in cross-section have been published previously@footnote 3-9@ without an adequate description of TEM specimen preparation though. TEM cross-sections of MS or ME tapes pose several unique problems during preparation. In this paper we will present a recipe for making cross-sectional TEM specimens which is especially benificial for brittle metal layers even on polymer base films, resulting in large homogeneous electron transparent areas and leaving the very fragile polymer tape substrate and glue layer completely intact. Our recipe proves to be a good alternative to the use of a microtome. Apart from the sample preparation method also some details of the deposition technique will be elucidated. @FootnoteText@ @footnote 1@ J. Jodge and Peng Tang, Private communication (1999), Quantum Corp., USA.,@footnote 2@ H. te Lintelo, Private communication (1999), IST Corp., Belgium.,@footnote 3@ S. Honodera, H. Kondo, and T. Kawana, MRS Bulletin. 21(9), 35 (1996).,@footnote 4@ H. Ho, G. Gau, and G. Thomas, J. of Appl. Phys. 65(8) , 3161 (1989).,@footnote 5@ K. Sato, K. Chiba, T. Ito, T. Ssaki, and J. Hokkyo, J. of Appl. Phys. 69(8), 4736 (1991).,@footnote 6@ J. Hokkyo, T. Suzuki, K. Chiba, K. Sato, Y. Arisaka, T. Sasaki, and Y. Ebine, JMMM 120, 281 (1993).,@footnote 7@ P. ten Berge, L. Abelmann, J. C. Lodder, A. Schrader, and S. Luitjens., J. of The Magnetics Society of Japan 18(S1), 295 (1994).,@footnote 8@ M.D. Bijker, E.M. Visser, and J.C. Lodder, Tribology International 31(9), 553 (1998).,@footnote 9@ H.J. Richter, IEEE Transactions on Magnetics 29(1), 21 (1993).

MI-TuP4 Magnetic Transition at the Gd(0001) Surface*, C.S. Arnold,*
D.P. Pappas, National Institute of Standards and Technology, Boulder

Controversy surrounds the magnetic ordering properties of the Gd(0001) surface. Several reports conclude that the surface has an it\{extraordinary} transition, ordering at a Curie temperature significantly higher than that of the bulk, while others reports have failed to reproduce this result. Our experiments unambiguously prove that the Gd(0001) surface has an ordinary transition. Furthermore, by analyzing both the bulk and surface magnetization, we show that Gd(0001) films are good realizations of semi-infinite, 3-dimensional Heisenberg ferromagnets with identical exchange couplings for surface and bulk, and identical Curie temperatures.

Author Index

Bold page numbers indicate presenter