PS12.01.21 MAGNETIC DEPTH PROFILES IN STRAINED NICKEL-IRON THIN FILMS MEASURED BY POLARIZED NEUTRON REFLECTOMETRY. F. Ott and C. Fermon, Laboratoire Léon Brillouin, C.E.A./C.N.R.S Saclay, 91191 Gif sur Yvette CEDEX

Polarized neutron reflectivity with polarization analysis enables one to determine in-plane vectorial magnetic depth profiles. We investigated the modifications of the magnetostrictive properties of nickel and nickel-iron thin films due to relaxation strains at the substrate/film and film/vacuum interfaces. The inplane magnetization rotation induced by a mechanical applied strain is shown to be non homogeneous throughout the layer. For a 100 nm iron-nickel thin film, the magnetization varies from 50° at the vacuum/film interface to 60° at the substrate(glass)/film interface. In a 40 nm nickel film, we observed that the magnetization rotation went up to 80° in the first 5 nm of the glass/nickel interface and decreased quickly to 34° in the rest of the layer.

Other measurements were made on trilayers systems Ni/NiFe/Ni and Ni/Ag/NiFe in order to observe the magnetic coupling between the layers. The magnetic alloys were chosen in order to have magneto-elastic constants of opposite signs so that the rotation directions induced by a strain are perpendicular for the two alloys. The Ni/NiFe/Ni system is shown to have a rather homogeneous magnetization whereas the Ni/Ag/NiFe trilayer exhibits magnetic rotation gradients in both layers.

Surfaces II
Thin Films & Multilayers

MS12.02.01 INTERFACE ROUGHNESS IN SPUTTERED W/Si MULTILAYERS AND RELATED GROWTH MODELS T. Salditt, T.H. Metzger, D. Lott, J. Peisl, Sektion Physik der Universitaet Muenchen, D-80539 Muenchen, Germany

The interface morphology and roughness of sputtered multilayers changes dramatically when the Ar-pressure is raised above the threshold value, where the impinging atoms are thermalized by collisions in the gas phase. The corresponding changes in the height-height self- and cross- correlation functions have been studied by diffuse x-ray scattering, and are compared to simple statistical models of kinetic roughening. At low pressures very smooth interfaces are observed in agreement with the Edwards-Wilkinson Langevin equation, while at high pressures a columnar interface structure is found that evolves according to the Huygens-principle growth model of Tang, Alexander, and Bruinsma. The microscopic origins of this behavior are discussed along with a possible explanation for the absence of the Kardar- Parisi-Zhang type of growth.

MS12.02.02 STUDY OF AL-C MULTILAYERS USING ANOMALOUS REFLECTIVITY AND HIGH QUANTUM WELLS USING RESOLUTION DIFFRACTION STUDIES OF MULTILAYERS. M.K. Sanyal[1], A.Datta[1], S. Banerjee[1], B.M. Arora[2], J. Basu[1], M.R. Mishra[1] , T. Ohkawa[3], Y. Yamaguchi[3], O. Sakata[3] and H. Hashizume[3]. [1]Saha Institute of Nuclear Physics, Calcutta 700 064, INDIA; [2]Tata Institute of Fundamental Research, Bombay 400 005, INDIA; [3]Tokyo Institute of Technology, Yokohama 226, JAPAN

We present here the results of structural studies of various multilayers using x-ray scattering techniques. To determine electron density profile of multilayers, we have used a recently developed [1] anomalous reflectivity technique where x-ray reflectivity profiles are measured at and away from the x-ray absorption edge of the substrate and these two profiles provide a model independent electron density profile of the measured sample as a function of depth. Here we present results [2] of our study of Aluminum-Carbon multilayers deposited on Germanium single crystal. The data was taken at Photon Factory synchrotron source, Japan. We also present results of high resolution diffraction measurements of single and double quantum well structures [InGaAs in InP (001) crystal]. The measurements were done at Saha Institute of Nuclear Physics and were prepared at Tata Institute of Fundamental Research, by MOCVD technique. The x-ray measurements were performed in double-crystal x-ray diffraction mode[3] and the data is being analyzed using a model based on Takagi-Taupin theory of dynamical diffraction. These measurements can provide information regarding lattice strain and interfacial structures.

1. M. K. Sanyal et al, Europhys. Lett. 21, 691 (1993);
2. T.Ohkawa et al, Physica B (In Press)
3. C.R.Wie, Mat.Sc.& Engg., R13, 1 (1994)

MS12.03.03 STRUCTURE AND MAGNETIC PROPERTIES IN MAGNETIC MULTILAYERS. Z.H. Mai, Y.S. Gu, G.M. Luo, M.L.Yan and W.Y.Lai, Institute of Physics, Chinese Academy of Sciences, Beijing 100080, China

Ultrathin magnetic multilayers with non-magnetic 4d-metal spacer Fe/Ag, Fe/Mo, Fe/Pd and Co/Pd grown by RF sputtering were studied combined X-ray small reflections, high angle diffraction, X-ray diffuse scattering, resistance measurement and vibration sample magnetometer. The results show that the magnetic properties of the magnetic multilayers are strongly structural dependent.

Ultrathin magnetic multilayers consisting of alternate layers of a magnetic metal separated by layers of a non-magnetic metal have profound signifi-cance in science and potential in applications. Since the first observation of giant magnetoresistance (GMR) effect in Fe/Cr multilayers by Baibich et al., great advances have been made in understanding of the subject.

The structural parameters of Co/Pd and Fe/Ag, Fe/Mo, Fe/Pd multilayers such as the periods, the interfacial roughness, the interplane distances and the grain sizes have been determined. In the Fe/Pd system, the densities of multilayers change abruptly with Pd layer thickness increase. The crystal structure of Fe layer changed from bcc to fcc when the Pd layer thickness $t_{Pd} \geq 3.6$nm.. In the Co/Pd system, the interfacial roughness increases from 0.2nm to 1.2nm as the Pd layer thickness t_{Pd} increases from 1nm to 6.4 nm. The saturate magnetization of Co/Pd multilayers oscillate with the Pd layer thickness. Structural abnormalities were found with nominal Pd layer thickness of 2.56nm and/or 1.28nm.

GMR effects in sputtered Fe/Ag and Fe/Mo multilayers were observed in first time. Both GMR and interlayer coupling of the adjacent magnetic layers possess the same periods which are 1.1nm for Fe/Ag and 1.2nm for Fe/Mo. The results suggest that the relatively rough interfaces and moderately thin Fe layer thickness are the key factors for enhancing GMR in the sputtered films.