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Keywords: multilayer thin films; X-ray reflectometry; X-ray rocking curve

FA2-MS06-P04

Thickness Optimization of Underlayer and Seed Layer for Spin Valves. Hakan Cinar[a], R. Mustafa Oksuzoglu[b], Mustafa Yildirim[c]. [a]*Department of Advanced Technologies, Graduate School of Science, Anadolu University, Eskisehir, Turkey.* [b]*Department of Material Science and Engineering, Anadolu University, Eskisehir, Turkey.* [c]*Department of Physics, Graduate School of Science, Anadolu University, Eskisehir, Turkey.*
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In recent years, magnetic spin valves (SVs) have been widely studied in terms of their potential application in high-density magnetic recording and high sensitivity magnetic sensing because of their low field magnetoresistance behavior. It is well known that underlayer and seed layer play significant role in the nanostructure properties of SVs like the preferential crystallite orientation (texture) [1] or to prevent interdiffusion with the substrate [2, 3]. Depending on the SV type (bottom or top) and materials of antiferromagnetic layer as IrMn [4, 5], PtMn [6], FeMn [7] different underlayers were used. Recently, same underlayer and seed layer systems have been investigated for IrMn based Top-SV systems using DC magnetron sputtering deposition (DC-MSD) at different thicknesses. Only in few studies, the IrMn based bottom-SVs were investigated. Kim et al. used Ta(5 nm)/NiFe(2 nm) for IrMn(7.5 nm)/CoFe(3 nm)/Cu(2.5 nm)/CoFe(3 nm)/Ta(5 nm) [4] and Han et al. Ta(3 nm)/NiFe(2 nm) for IrMn(6 nm)/CoFe(3 nm)/Cu(2 nm)/CoFe(3 nm)/Ta(3 nm) [8] SV structure. In both studies DC-MSD technique was used.
In this study, the effects of Ta underlayer, NiFe seed layer and their thickness on the microstructure properties of IrMn based bottom spin valves without spacer and free layer have been investigated. The Pulsed-DC magnetron sputtering technique have been used for the first time in this study to deposit the nano layer systems Ta(5 nm)/NiFe(x nm)/IrMn(10 nm)/CoFe (2 nm)/Ta(5 nm) and Ta(x nm)/NiFe(5 nm)/IrMn(10 nm)/CoFe(2 nm)/Ta(5 nm) (x = 2, 4, 6, 8, 10 nm) on Si/SiO_2 substrate. Their structural evolution was characterized using X-ray reflectometry, X-ray diffraction and rocking curve methods and electrical properties were determined by four point probe technique. We have found an optimum underlayer and seed thickness combination as Ta(8nm)/NiFe(8nm) with atomic smooth interfaces and reasonable texture for Giant Magnetoresistive type IrMn bottom SVs. Structure-property correlations of IrMn based SVs have been discussed.

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Keywords: multilayer thin films; X-ray reflectometry; X-ray rocking curves

FA2-MS06-P05

Influence of Deposition Technique on Growth and Resistivity of Ta/NiFe Nano Films. Ogeday Çapar[a], Mustafa Yıldırım[b], Hakan Çınar[a], Ramis Mustafa Öksüzoğlu[c]. *Department of Materials Sciences and Enginerring, Anadolu University, Eskisehir, Turkey.*
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Recently, soft magnetic NiFe permalloy thin films indicating Anisotropic Magnetoresistance (AMR) and Planar Hall Effect (PHE) [1,2] have attracted considerable attention due to their potential application in antiferromagnetic/ferromagnetic exchange bias in read sensors [3,4], magnetic and biosensors [5,6], and magnetic recording media [7]. DC magnetron sputtering technique (DC-MS) has become one of the most useful technologies to prepare AMR and PHE permalloy films for its high speed and stability [1-11].
In the present study, the correlation between electrical resistivity and nanostructure of Ta/NiFe sub 10 nm films deposited by Pulsed-DC magnetron sputtering have been investigated. Resistivity decreasing was determined , after fixed Ta and increasing NiFe thickness . The results were also comparison and discussed with films deposited by DC-MS technique.

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Keywords: X-ray reflectivity; X-ray diffraction; resistivity

FA2-MS06-P06

DFT Modelling of Defects in Strontium Titanate. Matthias Zschornak[a,b], Emanuel Gutmann[a], Hartmut Stöcker[a], Irina Shakhverdova[a], Torsten Weißbach[a], Tilmann Leisegang[a], Dirk C. Meyer[a], Sibylle Gemming[b]. [a]*Institute of Ion Beam Physics and*

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Strontium titanate ($SrTiO_3$) is an oxide crystallizing with cubic perovskite-type of structure that exhibits a high tunability of dielectric, electric, mechanical and optical properties by means of defects. Apart from dopants, also intrinsic oxygen vacancies or ordered stacking faults, e.g. Ruddlesden-Popper (RP) phases $SrO(SrTiO_3)_n$, may influence these properties.
We have investigated the structural stability, electronic properties and surface energies of such RP phases up to n = 5 by means of density-functional theory. We find a significant gain of formation energy up to n = 3 and can approximate the interaction range of neighbouring stacking faults to 11.7 Å. From band structure and density of states calculations we see a quasi continuous evolution of the band gap in an interval of about 0.4 eV beginning at RP n = 1 and approaching the $SrTiO_3$ bulk value for higher ordered members which suggests tunability by selection of an appropriate RP phase. Surface calculations will be presented for <001> and <100> directions with all possible perfect crystal terminations and several more complex structures.
Further, we have theoretically verified a reversible elastic softening along an O-deficient <001> direction recently found in nano-indentation of $SrTiO_3$ under influence of an electric field. The results of an isotropic as well as an anisotropic modelling of oxygen vacancy distributions in a 2x2x2 $SrTiO_{3-\delta}$ super cell will be presented.

Keywords: DFT; defects in oxides; surface structure and relaxation

FA2-MS06-P07

The Benefit of Nanoindentation for the Evaluation of Near-Surface Properties. Peter Paufler[a], Irina P. Shakhverdova[a], Dirk C. Meyer[a]. [a]*FR Physik, TU Dresden, D-01062 Dresden, Germany.*
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Nanoindentation tests are probing elastic and plastic properties by applying normal loads F<10mN and penetration depths $h \leq 0.2$ μm depending on the material investigated. Most impor- tantly, the whole dependence $F(h)$ is recorded throughout the loading - deloading cycle. The major mechanical entities ob- tained are the (reduced) Young's modulus E_r and the nano-hardness H. The former $E_r = (dF/dh) /c\ Amax$ is derived from the slope of the initial portion of the unloading curve $F(h)$ and the projected area of contact A_{max} at maximum load, where c is of the order of 1 and depends on the shape of the indenter [1]. For the latter $H = F(h_{max})/A_{max}$ holds at the maximum penetration depth h_{max}. There are several benefits of the small volume activated mechanically: (1)The properties of thin films may be characterised separately. (2)Both lateral and in-depth resolution down to some nanometers enables composition gradients to be assessed. (3) E_r and H may be obtained directly from $F(h)$. When using the nanoindenter in conjunction with an atomic force microscope, the nanoindent may be imaged *in-situ*. (4)Thanks to the relationship $Y = H/3$ the yield stress Y of nanolayers or near-surface regions may be obtained, which is otherwise difficult to assess.(5) High pressures underneath the indenter enable phase transitions to be studied. (6) Confinement of the small indented volume by the surrounding material prevents the sample from global fracture. (7) Fracture toughness of thin films and near surface regions may be calculated from cracks. (8) Because the diameter of indents is generally smaller than the average spacing of dislocations in crystals, elementary mechanisms leading to permanent deformation of defect-free regions might be identified. In particular, the generation of mobile dislocations at the beginning of the deformation process may be revealed directly. - The following materials have been studied and above- mentioned parameters determined: crystalline S_rTiO_3 [2] and Li_3O_5 [3]; nanoporous borosilicate glass [4]; quasicrystalline i-YMgZn, i-AlPdMn and d-AlCoNi [5]; ultra-high carbon steel [6]; metallic glass Cu-Ti-Zr-Ni-Si-Sn [7], and VC/TiC multilayers on Si or Al_2O_3.

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Keywords: hardness; elastic properties; surface characterization

FA2-MS06-P08

Texture Measurements on Thin Films Using an X-ray Microfocus Source. Bernd Hasse[a], Jürgen Graf[a], Carsten Michaelsen[a]. [a]*Incoatec GmbH, Max-Planck-Straße 2, 21502 Geesthacht, Germany.*
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We will present texture measurements of components of high-temperature superconducting coated conductors. We used a state-of-the-art diffractometer which was equipped with a 2-dim detector and the new Incoatec Microfocus X-ray Source IμS. The IμS is a 30 W air-cooled sealed X-ray tube. It has all advantages of a sealed tube, it is maintenance free and it needs no cooling water. In the IμS the beam was collimated with the special multilayer optics for a two dimensional beam-shaping, the so-called Quazar Optics. The source was integrated in a Bruker D8 GADDS system with VÅNTEC-2000 detector. This setup for two dimensional diffractometry is especially useful for the investigation of powders as well as for materials characterization like thin films.
With our new equipment we analyzed the texture of metallic substrates produced by the RABiTS technology (rolling