Acta Cryst. (2002). A**58** (Supplement), C348

CRYSTALLIZATION OF SOL-GEL-DERIVED STRONTIUM-BISMUTH-TANTALATE THIN FILMS ON SILICON SUBSTRATES

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Crystal structure of sol-gel derived $SrBi_2Ta_2O_9$ thin films (thickness < 100 nm) deposited on silicon substrates has been investigated as a function of annealing temperature and time by means of X-ray diffraction. P-type Si(100) substrates were treated in a diluted HF solution after chemical cleaning and subsequently a precursor solution for $SrBi_2Ta_2O_9$ was deposited on the Si substrates by spin coating technique. After drying at 423 K in the atmosphere the samples were annealed in a furnace. At annealing temperatures of 823-973 K the crystallization from amorphous phase to a fluorite-type structure (space group: *Fm*3*m*) was confirmed, but a ferroelectric phase (space group: $A2_1am$) was not observed even after annealing for 10 hours. As annealing temperature was higher than 1003 K, at first diffraction only from the fluorite-type structure was observed, and then diffraction from $A2_1am$ structure appears after a specific time t_0; it depends on the annealing temperature. The diffraction intensities from the fluorite-type structure decreased and those from $A2_1am$ structure increased with annealing time. Finally diffraction only from the $A2_1am$ structure was observed. These results mean that crystal structure of the $SrBi_2Ta_2O_9$ thin film was gradually transformed from fluorite into $A2_1am$ structure with time. By atomic force microscope it was confirmed that grain growth occurred simultaneously with the structural transformation. Furthermore, X-ray reflectivity analysis indicated that an interfacial layer was formed during the crystallization and the thickness of the layer increased with annealing time.

Keywords: FERROELECTRIC THIN FILMS, STRONTIUM BISMUTH TANTALATE (SBT), CRYSTALLIZATION

Acta Cryst. (2002). A**58** (Supplement), C348

RAMAN STUDIES OF AMORPHOUS AND MICROCRYSTALLINE PHASES OF SILICON FILMS PRODUCED BY PECVD

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We have realized a Raman scattering study of aluminum induced microcrystalline films of phosphorous-doped hydrogenated amorphous silicon (n+ a-Si:H). These thin films of heavily doped (n+ a-Si:H) were prepared by Plasma Enhanced Chemical Vapor Deposition (PECVD). Aluminum was deposited followed of an annealing process at 250 ºC in nitrogen ambient during several hours. Raman results reveal the presence of small microcrystalline regions distributed in the amorphous matrix. We used the spatial correlation model to estimate the size of the microcrystallites formed and its relation with the annealing time. This estimated crystallite size was found to be between 68 and 95 Å. The broadening and downshift of the signals are explained in terms of the crystallite size and lattice expansion effects.

Keywords: MICROCRYSTALLINE SILICON, AMORPHOUS SILICON, PECVD DEPOSITION

Acta Cryst. (2002). A**58** (Supplement), C348

STRUCTURAL CHARACTERIZATION OF Ag AND Mo-DOPED Fe-Pt THIN FILM PREPARED BY RADIO FREQUENCY SPUTTERING

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Undoped Fe-Pt and non-magnetic element doped Fe-Pt-X (X: Ag, Mo) thin films were prepared on oxidized silicon substrate by radio frequency sputtering methods with various sputtering time. The as-deposited films were annealed between 400^{o}c and 750^{o}c in order to transform the soft magnetic, disordered cubic to the hard magnetic, ordered tetragonal phase. Thickness of the films measured by x-ray reflectometry is ranged from 20 to 150 nm. Electron probe microanalysis showed that chemical composition of the undoped and doped film is $Fe_{0.54}Pt_{0.46}$ and $(Fe_{0.54}Pt_{0.46})_{0.96}X_{0.04}$ (X: Mo, Ag). X-ray diffraction, transmission electron microscopy, atomic force microscopy studies showed that the addition of Mo and Ag in to $Fe_{0.54}Pt_{0.46}$ thin film inhibit the grain growth during annealing of the samples. The undoped $Fe_{0.54}Pt_{0.46}$ thin film have in-plane anisotropy and no orientation while the Ag and Mo-doped thin film with the thickness less than 75 nm have the preferred (0 0 1) orientation of the ordered tetragonal phase were obtained when annealing temperature reached 625^{o}c for 15 min. And consequently out-plane anisotropy as determined by magnetic hysteresis. All above results showed that sputtered Ag and Mo-doped $Fe_{0.54}Pt_{0.46}$ thin films, which have both nanostructure and out-plane anisotropy, can become a potential candidate for a new perpendicular media.

Keywords: THIN FILM STRUCTURAL CHARACTERIZATION DOPED FEPT

Acta Cryst. (2002). A**58** (Supplement), C348

METASTABLE PHASE FORMATION AND SUBSEQUENT THERMALLY STIMULATED RELAXATION OF CO-DEPOSITED Fe-Cr NANOMETER FILMS

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The Fe-Cr alloy system has a wide miscibility gap at ambient temperature. Using crossed beam pulsed laser deposition we prepared a series of nanometer films consisting of a mixture of Fe and Cr atoms and covering the whole binary composition range. The phase formation in this system after deposition and after subsequent thermal treatment up to 1100ºC was examined by wide-angle X-ray diffraction and X-ray absorption fine structure measurements. The combination of long- and short-range order information enabled regions of solid solution and ordered intermetallic compounds to be discriminated. As a result of our experiments the existence range of at least three phases which have not been described so far could be determined. During heat treatment characteristic crystalline phase sequences were observed.

It is particularly noteworthy that for equiatomic composition after deposition as well as after annealing an ordered structure (A15-like, orthorhombically distorted) has been observed. While the formation of ordered structures was generally expected, the specific type of structure found is in contradiction to theoretical predictions for the equilibrium state in Fe-Cr bulk material of the same composition. Following Turchi et al. A new ordered superstructure (different from A15) should be more stable than a random alloy whereby segregation is still energetically preferred. Structural evolution when changing composition is found in accordance with that expected theoretically. The differences observed are due to the non-equilibrium conditions during preparation and to the impact of the surface upon structure of thin layers.

Keywords: THIN FILMS SHORT-RANGE ORDER ALLOYS