11-Surfaces, Interfaces and Thin Films

PS-11.02.10 RESONANCE ENHANCED X-RAYS IN THIN FILMS: A NEW STRUCTURE PROBE FOR MEMBRANES AND SURFACE LAYERS. By J. Wang and M. Caffrey*, Department of Chemistry, The Ohio State University, U.S.A.; M. J. Bedzyk, Department of Materials Science and Engineering, Northwestern University and Material Science Division, Argonne National Laboratory, U.S.A..

Phenomena associated with x-rays glancing off a flat surface or mirror have become the focus of attention in many research fields and have been applied to surface and thin film related structure analysis. Recently, we have shown that x-ray standing waves generated during total external reflection at a gold mirror surface are well defined at up to 1,000 Å above the surface (Wang *et al.*, Nature, 1991, 354, 377-380). The theoretical calculations described in the latter study indicated the existence of a potentially useful resonance effect which markedly enhances the electric field (E-field) of the penetrated x-rays in the organic thin film at low angles of incidence under certain interference conditions. In excellent agreement with theory, we have demonstrated experimentally that the primary resonant x-ray E-field confined in the organic thin film is 20 times more intense than that of the incident beam when measured at a position close to the center of the film (Wang *et al.*, Science, 1992, 258, 775-778).

To verify experimentally the existence of resonantly enhanced x-rays in a mirror supported thin film the following strategy was used. A hydrophobic gold mirror with 16 bilayers of w-tricosenoic acid and an inverted bilayer of either zinc or manganese arachidate placed at the center of the lipid multilayer was prepared by the Langmuir-Blodgett technique. This arrangement positioned the heavy atom layer approximately at the center of the organic thin film. The photoelectic effect, evidenced by x-ray fluorescence, is proportional to the E-field intensity at the center of the heavy atom layer. Thus, the intensity of x-ray fluorescence from the heavy atom layer as a function of the incident angle is a direct measure of the E-field intensity at the position of the probe atom in the adlayer at an incident x-ray energy of 9.8 or 7.0 keV chosen to excite optimally zinc or manganese K_α-fluorescence, respectively. The resonantly enhanced fluorescence yield was observed at 2.33 mrad for the zinc sample and at 3.51 mrad for the manganese sample as predicted. The sizable E-field intensity enhancement demonstrated here means that the significance of this new resonance effect goes beyond the realm of x-ray physics and x-ray devices and extends into the domain of thin film characterization.

PS-11.02.11 STRUCTURAL AND ELECTRICAL PROPERTIES OF SnTe FILMS GROWN BY RAPID THERMAL PROCESSING TECHNIQUE. By NIDHI SINHA*, A. O. MOHEMMAD & P. C. MATHUR, Department of Electronic Science, Delhi University, Delhi, INDIA.

Rapid Thermal Processing (RTP) has emerged as an important technique for various applications [SINGH, R. (1988), J. Appl. Phys., 63, p. R59]. In the present paper, we report the growth of single phase SnTe films using this technique.

Elemental layers of Sn & Te were deposited onto quartz substrate (at 150°C) by evaporating 5N pure materials. The stoichiometry was achieved by controlling the thickness of individual layers with the help of thickness monitoring unit. After deposition, the films were subjected to rapid thermal annealing at different temperatures (450°C to 600°C) for different durations (30 sec. to 2 min.). XRD studies were made on all the films using CuK_α radiation in the range $2\theta = 20°$ to 50°. It was observed that the films were always single phase with preferred orientation of 200 & 220 planes.

The D. C. electrical conductivity and Hall mesearment studies were made on these films. It was observed that these films have properties comparable to those grown by conventional vacuum evaporation technique. The electrical parameters and crystallenity were found to depend on temperature and duration of RTP, thus providing scope for improvement in the quality of thin films. Also, RTP technique is less time and energy consuming as compared to the conventional vacuum evaporation method.

PS-11.02.12 STRUCTURE OF MONOATOMIC S AND Se LAYER ON GaAs. By Asao NAKANO[1], Shinichiro TAKATANI[2], Takuo TAMURA[1] and Kiyoshi OGATA[1]. *1:Production Engineering Research Laboratory, Hitachi, Ltd., Totsuka, Yokohama 244, 2:Central Research Laboratory, Hitachi, Ltd., Kokubunji, Tokyo 185, Japan.*

Chemical surface passivation using $(NH_4)_2S_x$, Na_2S or H_2S were studied in order to obtain an electronic quality of GaAs surfaces[1]. Although surface reconstructions are observed for these surfaces by electron diffraction measurement, the detailed structure of the surfaces has not been determined.

S/GaAs(001) and Se/GaAs(001) with a thickness of about 0.5 nm, were prepared by chemisorption and MBE methods, respectively. Fluorescence yield XAFS of S*K*α and Se*K*α were measured using a Si(Li) detector with area of $3\times80mm^2$ under the total reflection condition on the beam line, BL-8B, at Photon Factory of KEK. The interatomic distances of the first nearest neighbour indicate the existence of Ga_2S_3 and Ga_2Se_3 type surface structures on the S and Se treated GaAs wafers, respectively. The difference of coordination numbers among the //<110> and ⊥<110> measurements is caused by the porlarization of the synchrotron radiation and the ordering of the surface structure.

Table.1 Results of the analyses (*:normalized by GaSe(=3))

Sample	R1(nm)	σ(nm)	Coordination
S/GaAs//<110>	0.2219(1)	0.0049(2)	1.41(4)
S/GaAs⊥<110>	0.2222(1)	0.0062(1)	0.58(1)
Se/GaAs	0.2432(1)	0.0085(2)	2.9*(1)

Ref.: 1) H.Sugahara *et al.*: Surface Science, **242** (1991), 335.

