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.Y. 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 penetrating 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 tricicosanoic acid and an inverted bilayer of either zinc or manganese arcachide 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 photovoltaic 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 thin film. The resonantly enhanced fluorescence yield was observed at 2.53 meV for the zinc sample and at 2.51 meV for the manganese sample as predicted. The x-ray 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. MOHENNAD & 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 SI 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 500 °C) for different durations (30 sec. to 2 min.). XRD studies were made on all the films using CuKα radiation, in the range 2θ = 20° to 90°. It was observed that the films were always single phase with preferred orientation of 2θ = 220° planes.

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

PS-11.02.12 STRUCTURE OF MONOAOTOMIC S AND Se LAYER ON GaAs. By Asao NAKANO1, Shinichiro TAKAWA2, Takao TAMURA2 and Yosiohito OGATA2. 1: Production Engineering Research Laboratory, Hitachi, Ltd., Tohoku, Yokohama 244, 2 Central Research Laboratory, Hitachi, Ltd., Kokusan, Tokyo 185, Japan.

Chemical passivation using (NH₄)₂S, Na₂S or H₂S was studied in order to obtain an electronic quality of GaAs surfaces. Although surface reconstructions are observed for these surfaces by electron diffraction measurement, the detailed structure of the surfaces has not been determined.

GaAs(001) and SeGaAs(001) with a thickness of about 0.5 nm, were prepared by chemisorption and MBE methods, respectively. Fluorescence yield XAFS of Se and GaAs were measured using a Si(Li) detector with an energy resolution of 3x80 eV under the total reflection condition on the beam line, BL-8B, at Photon Factory of KEK. The interatomic distances of the nearest neighbour indicate the existence of Ga₅Se₂ and Ga₅Se₄ type surface structures on the S and Se treated GaAs wafers, respectively. The difference of coordination numbers among the γ(110°) and θ(110°) measurements is caused by the polarization of the synchrotron radiation and the ordering of the surface structures.

<table>
<thead>
<tr>
<th>Sample</th>
<th>R1(Å)</th>
<th>c(Å)</th>
<th>Coordination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si/GaAs(001)</td>
<td>0.2219(1)</td>
<td>0.8049(2)</td>
<td>1:1(4)</td>
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<tr>
<td>Se/GaAs(001)</td>
<td>0.2222(1)</td>
<td>0.8062(1)</td>
<td>0.58(1)</td>
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<tr>
<td>SeGaAs</td>
<td>0.2432(1)</td>
<td>0.8085(2)</td>
<td>2.9(1)</td>
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</tbody>
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