

crystalline layers at and below the interface, can be interpreted in terms of a roughening of the crystal surface. Trajectory plots normal to the interface show the onset of a cooperative melting process, and consequent distortions of the nearby crystal penetrate to 4-5 layers below the interface.

Results from constant volume and triple point calculations designed to suppress these movements will be presented, and the detailed structure of the equilibrium interface discussed.

tendency for segregation of tin atoms with  $\sim$  similar electronic states into groups of similar substructures, as a rule in incommensurate states. Above 500°C, the number of incommensurate substructures decreases, and there is tendency for decrease of  $\delta$ . The various tin substructures tend to form single crystal islands. It has been observed that Sn(Si) gets far less oxidized than the other tin substructures. SnO(SiO) is the common initial oxide observed as islands on all types of thin tin films and in chemically vapour grown tin oxide films (TOF) (e.g. Abstr. ICGG-6, Moscow, 1980, 4, 253; J. Crystal Growth, 73 (1981) in press). RHEED and DSMS show that there are at least two mechanisms for further oxidation of SnO(SiO). The first mechanism is a regular phase transformation of SnO(SiO),  $a = 6,42 \text{ \AA} + 0,05 \text{ \AA}$  into tin perovskite (pseudocubic)  $a = 7,48 \text{ \AA} \pm 0,07 \text{ \AA}$ , or phase transformations of incommensurate SnO(SiO) into incommensurate perovskites, resembling the data of CaSnO<sub>3</sub>, ASTM 3-0755. The second mechanism resembles very much the oxidation of titanium oxides. The observed interplanar distances in the row of incommensurate SnO<sub>x</sub> structures are very similar to the interplanar distances of the different TiO<sub>x</sub>, as given in the ASTM Tables.

**07.2-03** METASTABLE PHASES IN THIN TIN AND LEAD FILMS AND THEIR OXIDES. By S.K. Peneva, K.D. Djuneva and D.D. Nihtianova, University of Sofia, Chemical Faculty, 1, Anton Ivanov Rd., Sofia 1126, Bulgaria.

RHEED studies have shown that diamond cubic structures with lattice parameters around the lattice parameter of silicon exist both in thin Sn and Pb films and in massive tin and lead solidified in vacuum  $\sim 5 \cdot 10^{-6}$  Torr, designated respectively as Sn(Si) and Pb(Si). It was found that three tin and lead intermediate oxides have almost identical structures. The initial oxides of Sn(Si) and Pb(Si) were identified as tin and lead analogues of SiO, demonstrating the similarity between tin and lead not only in the initial stages of crystallisation, but in the initial stages of oxidation (Peneva et al., J. Cryst. Growth, 53 (1981) in press). Depth selective Mössbauer Spectroscopy (DSMS) studies have shown a very high positive value of the isomeric shift  $\delta$  of Sn(Si)  $+ 4,42 \pm 0,34$  mm/s, relative to tin dioxide (Djuneva et al., Thin Solid Films 67 (1980) 371). Different other tin substructures were observed at different evaporation velocities, obtained by changing the temperature of the source, mostly in incommensurate states. Textured  $\alpha$ -Sn films were grown with  $\delta = + 2,2 \pm 0,27$  mm/sec, relative to tin dioxide. Films containing simultaneously textured  $\alpha$ -Sn and tinI/tinII intermetallic compound, with structure resembling the structure of CuAu and isomeric shift  $\delta$  (SnI.SnII(CuAu)) =  $1,00 \pm 0,27$  mm/s, relative to tin dioxide were also detected. It appears that the structure of tin and lead films depends on the structure of different metallic clusters coming from the vapours (e.g. Honig, J. Chem. Phys. 21 (1953) 573). Popel et al. (Fizika Metallov i Metallovedenie, Russan, 2, 38 (1974) present diffraction evidence for cluster structures in molten tin. Heating of thin tin films up to 400°C leads to complicated multiphase textures, with displaced 000 points of the reciprocal lattices of the various phases. There is

**07.2-04** ANALYSIS OF AIR EXPOSED SURFACE OF Cr, Fe and Al. By Fumio Watari and J. M. Cowley, Arizona State University, Dept. of Physics, Tempe, AZ 85281 USA

When the fresh surface of Cr, Fe and Al is exposed to air at 300°K, an oxide layer is formed over the surface. This is confirmed and its composition and structure can be analyzed by scanning transmission electron microscopy (STEM) with the specimens prepared either outside the microscope or by in-situ evaporation followed by air-exposure.

The thin films prepared by evaporation, then exposed to air outside the microscope, had their thickness changed systematically from 10 to 1500 Å. Without use of a supporting film and with the availability of relatively larger uniform area and easier control of thickness, they provide suitable conditions for quantitative analysis. In order to compare the specimens before and after air exposure and to eliminate the possible influence of substrate and water, in-situ evaporation was performed in vacuum better than  $1 \times 10^{-7}$  Torr. Besides the use of carbon film as substrate, a whisker of CuO with about 200 Å diameter was also used and metal deposits were crystallized around it.

In all these metals, oxide formation was detected by electron energy loss spectroscopy. The increase of oxygen pick-up in aging at 300°K was observed in Fe. The composition of oxide layer is roughly 0.5 and 1 in ratio of cation/anion and the thickness about 10 Å and 100 Å for Cr and Fe respectively. Microdiffraction with the probe size about 15 Å in diameter shows diffuse scattered pattern for some time after specimen preparation, suggesting an amorphous structure. The intensity profile for the initial state of oxide structure was taken from selected area diffraction patterns using the line scan mode. Radial distribution analysis showed the cation-cation nearest neighbor distance to be about 3.4 Å for Fe and Cr.