Preparation and Characterisation of Pyrolytically-Deposited Thin Oxide Films from Metal-Organic Compounds.

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Abstract:

A simple and versatile pyrolytic method of preparing thin metal oxide films that is based on the Metal Organic Chemical Vapour Deposition (MOCVD) technique and that is operative at relatively low temperatures (420°C) has been utilised to prepare the thin metal oxide films of indium, zinc, aluminium and copper from the appropriate metal acetylacetonate or carboxylate.

To fully understand the pyrolytic route leading to film formation, the thermal decomposition of some of the starting materials was investigated in detail at 420°C in air and N,, using separately, a Muffle furnace and a flow system. The identities of the products as determined by a combination of techniques are Cu, CO_2, a carboxylic acid and an odd chain-length alkene, in the case of the copper(II) soaps; ZnO, CO_2 and a ketone for the zinc soaps; and a mixture of Cu, Cu_20 and CuO in the case of the copper(II) acetylacetonate. While mechanisms have been proposed to account for the degradative routes of the soaps, which of the metal acetylacetonates is still inconclusive.

A combination of Ion Beam, X-ray and optical absorption studies have shown that the oxide films of indium, zinc and aluminium are, of the expected stoichiometry, while that of copper is of mixed composition ($CuO/Cu_2O/Cu$). It is not immediately clear why carbon and alkali metal contamination was observed for the Al_2O_3 and $CuO/Cu_2O/Cu$ films but not for the In_2O_3 film. Scanning Electron Microscopy (SEM) has shown the films to be polycrystalline. The observed optical characteristics (high transmittances, T = 75-90%; moderate reflectances, R < 21%; low absorbances, A < 8%; high refractive indices, n_f > 1.5 and low extinction coefficients, k < 0.4) are as expected for these thin films. Potential uses of these thin layers based on their observed properties are also discussed.

Keywords: Organic metal/ pyrolytic/ carboxylic acid / stoichiometry/ scanning electron microscopy (SEM)

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