Growth and Characterization of Superconducting In and Pb Films

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Elemental In and Pb films ranging in thickness from 400 - 2000 nm have been grown on glass (SiO_2) and other substrates using vacuum vapor deposition. Film growth was monitored and controlled by *in-situ* four-point probe resistance measurements. Samples grown concurrently were analyzed using several techniques: X-ray Transmission for thickness measurement and X-ray Diffraction for morphology, structure, and composition of the films. The In films exhibited a tendency to grow in the (101) direction, with slight variations caused by the deposition rate. Ambient temperature transport measurements and temperature scans down to below the superconducting transition temperature (T_c) were carried out, with transition temperatures consistent with bulk metals. The films exhibit high residual resistance and temperature coefficients of $0.003/K$ for Pb slightly lower than published bulk measurements and $0.001/K$ for In. Using the Matthiessen's rule and the Drude model for conduction in metals, the crystallite or grain size was inferred to be an order of magnitude lower as compared to that obtained from X-ray diffraction using the X-ray peaks' full width at half maximum (FWHM), suggesting a preferred direction growth of the In crystallites on glass, but not for Pb. Some In sample films were annealed at 150 C^o in Ar or N_2 to improve on their morphology.