GRAIN SIZE EFFECTS ON THE REACTIVITY

OF

THERMALLY DEPOSITED AND ELECTRODEPOSITED

COPPER AND TIN THIN FILMS

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ABSTRACT

Copper and Tin thin films having different average grain sizes were prepared on titanium (Ti) and nickel (Ni) plates by thermal deposition and electrodeposition respectively. In the thermally deposited thin films, a variation of grain size was observed when the source to substrate distance was changed. The variation of the deposition temperature caused grain size variation in the electrodeposited thin films. X-ray diffraction (XRD) was used to study the average grain size of the films, reactivity and microstrain of the samples. In addition, scanning electron microscopy (SEM) was used to study the morphological properties of the samples.

The average grain size and microstrain of Cu and Sn thin films were estimated using the full width at the half maximum (FWHM) and integral breadth of Cu (111) and Sn (200) diffraction peaks respectively. Then the Cu films were annealed at several temperatures in the range of 200 ^{0}C to 700 °C. Analogous measurements were carried out in the temperature range between 100 ^{0}C to 550 °C for Sn films. Effects of annealing in air were studied using XRD and SEM. For the films, a variation in the reactivity in air and a variation in microstrain were observed as a function of the grain size. Electrodeposited Cu thin film samples having a relatively large grain size showed less lowering of the oxide formation temperature compared to thermally deposited samples that had smaller grain sizes. Temperature of disappearance of the first Sn phase could not be identified due to its melting point (at 232 °C).

Results indicated that the reactivity of Cu thin films showed a larger grain size dependence compared to that of the Sn thin films. The formation temperature of Cu_2O of the Cu thin film having the smallest grain size occurred at a temperature of about 100 ^{0}C less than the thin film having the largest grain size. The formation temperature of SnO of the Sn thin film having the smallest grain size occurred at a temperature of about 50 ^{0}C less than the thin film having the largest grain size. The microstrain of both thin films showed similar behavior as a function of the grain size.