

Growth of Cu and Ag Thin Films by the Successive Ionic Layer Adsorption and reaction (SILAR) - Method

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Copper is used as a conductor material in electronic devices such as printed circuit boards. Copper films have been grown in industrial scale for instance by electrochemical methods and electroless deposition.

In the Successive Ionic Layer Adsorption and Reaction (SILAR) - method thin films are grown from the precursors in solution via a chemical reaction at room temperature and normal pressure. The metal-ion precursor solution and the reducing agent solution are in different vessels so that the growth of the film can be controlled more accurately compared with electroless deposition. In between the reaction steps the film is rinsed, so that only the adsorbed species stay on the film surface. Hence, ideally the film can grow layer by layer in the SILAR process.

Metal thin films were grown on reduced indium tin oxide (ITO) covered glass, gold and molybdenum substrates. Also polymer substrates (polycarbonate and PVC) were used for both metal films. Copper acetate solution (0.01 M pH 5.5) and a reducing solution, a highly basic aqueous solution of formaldehyde (10% HCHO, pH 14) were used for Cu films. Silver acetate (0.01 M pH 6.5) and tin (II) chloride (0.005 M) or tin(II)oxide (0.01 M + HNO₃, pH 1.5) were used as precursors for silver films.

The first stages of the growth of Cu films were analyzed by scanning electron microscopy and by atomic force microscopy. The film growth mode was clearly island growth on all substrates. The thicker films were continuous and homogeneous. The best films were grown on reduced ITO substrate, but also on polymer substrates a well-defined homogeneous copper film could be grown.

The SILAR grown copper films were polycrystalline, with no specific orientation and showed only the peaks of copper. Silver films on PVC showed already after 30 growth cycles the three major peaks of.

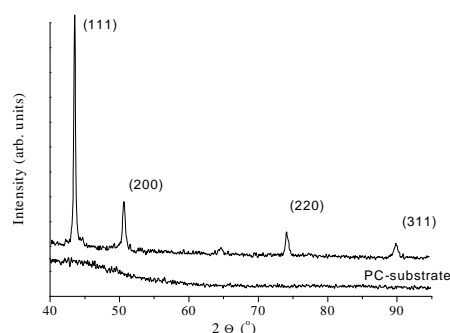


Figure 1. XRD spectra of SILAR grown Cu film (~100 nm) on polycarbonate.

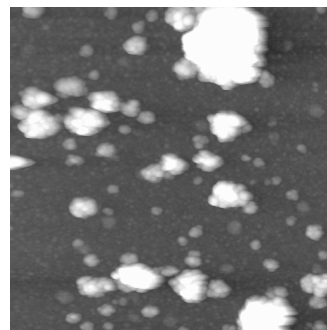


Figure 2. AFM image (1x1 μm²) of Cu on Mo after 10 SILAR cycles

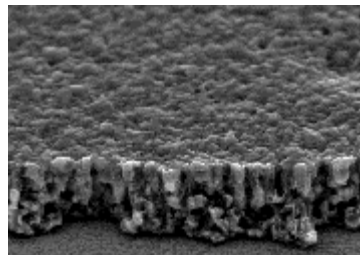


Figure 3. SEM image of a thicker (~400 nm) Cu film on ITO