ACTIVITY OF HALIDE-FREE CARBOXYLIC ACID FLUXES AT SN SURFACES

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A good solder joint mechanical adhesion can be only achieved by an intermetallic reaction of the under bump metallization (UBM) with at least one component of solder alloy (1). Mostly, UBM stacks consist of Cu pads coated with adhesion layers (Cr), diffusion barriers (Au) and sometimes capped with a metal like Ni for soldering(2). Conventional solders are typically on the base of Sn alloys with different ratios of individual elements like Ag and Cu (3). After a reflow process, new solid phases with intermetallic compounds (IMC) would be formed between the UBM and solder. The role of flux is to remove oxides and other contaminants from the substrates and to prevent the reoxidation of the substrates and solder during reflow(4). Although the other material and processes associated with flip-chip soldering are relatively well-defined (5-7), the interactions between flux and solders remain poorly understood.

Thermodynamically, Sn (II) and Sn (IV) can form different kinds of complexes with carboxylic acid under different pH value. (8) Equilibrium coefficients of aqueous Sn (II) and Sn (IV) citrate complexes are well defined.(8) (9) In nonaqueous circumstances, equilibrium coefficients between complexes are undetermined in literature.

In this work, the electrochemistry of carboxylic acid containing solutions with Sn-based solders was considered. Adipic acid, maleic acid and diglycolic acid were investigated using Sn/SnO_2, Sn/Cu, Sn/Ag/Cu electrodes. Equilibrium coefficients between Sn (II) and Sn (IV) carboxylate complexes were obtained using chronopotentiometry and pH meter. Hydrochloride acid was used here for comparison purpose. X-ray photoelectron spectroscopy (XPS) was performed to confirm surface compositions. Potential-pH diagrams of Sn-adipic-PEG and Sn-maleic-PEG were constructed and presented.

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