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The Substitution of Inkjet-printed Gold Nanoparticles for Electroplated Gold Films in Electronic Package

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Over the past few decades, metallic nanoparticles (NPs) have been of great interest due to their unique mesoscopic properties which distinguish them from those of bulk metals; such as lowered melting points, greater versatility that allows for more ease of processability, and tunable optical and mechanical properties. Due to these unique properties, potential opportunities are seen for applications that incorporate nanomaterials into optical and electronic devices. Specifically, the development of metallic NPs has gained significant interest within the electronics field and technological community as a whole. In this study, gold (Au) pads for surface finish in electronic package were developed by inkjet printing of Au NPs. The microstructures of inkjet-printed Au film were investigated by various thermal treatment conditions. The film showed the grain growth as well as bonding between NPs. The film became denser with pore elimination when NPs were sintered under gas flows of N_2-bubbled through formic acid (FA/N_2) and N_2, which resulted in improvement of electrical conductance. The resistivity of film was 4.79 $\mu\Omega$-cm, about twice of bulk value. From organic anlayses of FTIR, Raman spectroscopy, and TGA, the amount of organic residue in the film was 0.43% which meant considerable removal of the solvent or organic capping molecules. The solder ball shear test was adopted for solderability and shear strength value was 820 gf (1 gf=9.81 mN) on average. This shear strength is good enough to substitute the inkjet-printed Au nanoparticulate film for electroplating in electronic package.

Keywords: Inkjet printing, Gold, Nanoparticle, Electronic package

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Improvement of Electrical Properties by Controlling Nickel Plating Temperatures for All Solid Alumina Capacitors

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Recently, thin film capacitors used for vehicle inverters are small size, high capacitance, fast response, and large capacitance. But its applications were made up of liquid as electrolyte, so its capacitors are limited to low operating temperature range and the polarity. This research proposes using Ni-P alloys by electroless plating as the electrode instead of liquid electrode. Our substrate has a high aspect ratio and complicated shape because of anodic aluminum oxide (AAO). We used AAO because film thickness and effective surface area are depended on for high capacitance. As the metal electrode instead of electrolyte is injected into AAO, the film capacitor has advantages high voltage, wide operating temperature, and excellent frequency property. However, thin film capacitor made by electroless-plated Ni on AAO for full-filling into etched tunnel was limited from optimizing the deposition process so as to prevent open-through pore structures at the electroless plating owing to complicated morphological structure. In this paper, the electroless plating parameters are controlled by temperature in electroless Ni plating for reducing reaction rate. The Electrical properties with I-V and capacitance density were measured. By using nickel electrode, the capacitance density for the etched and Ni electroless plated films was 100 nFcm-2 while that for a film without any etch tunnel was 12.5 nFcm-2. Breakdown voltage and leakage current are improved, as the properties of metal deposition by electroless plating. The synthesized final nanostructures were characterized by scanning electron microscopy (SEM).

Keywords: Thin film capacitor, Electroless plating, Aluminum anode oxide (AAO)