**Advanced Metallizations for Avdanced Semiconductor Packaging**

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In recent years, many researches have been focused on the miniaturization of the integrated circuit (IC) feature size to improve the performance of semiconductor devices. However, we are facing the problems such as physical limit of the miniaturization and then increasing processing cost. To overcome these problems the Through-Si-Via (TSV) interconnection, a kind of the 3D interconnection, is a promising technology that could achieve high density, lower energy consumption and high performance in the IC.

Since the TSV filling process is costly in the entire TSV process, the TSV filling process which the Cu electrodeposition for TSV is one of key processes. The TSV bottom-up filling which the filling of Cu from the bottom to the top of via with suppressed lateral growth is the solution to ensure a void free filling in high aspect ratio TSV. The bottom-up filling could be achieved by using additives like a suppressor and an accelerator in the electrolyte.

In a theoretical model, the suppression breakdown at the bottom of TSV cause the bottom-up filling of TSV.Simultaneous desorption of suppressor by high potential due to ion depletion in the via bottom leads focus of current at the via bottom. Due to adsorption/desorption behavior of the suppressor, the bottom-up TSV filling could be achieved by only using the suppressor.Furthermore, it was reported that the suppressor at the sidewall is replaced by the accelerator and then the bottom-up filling performance was degraded.In our previous studies, the TSV bottom up filling with single additive using only suppressor successfully had accomplished.

Mechanical properties of the Cu thin film is significantly enhanced by highly dense coherent twin boundaries without the degradation of electrical conductivity. Because it could effectively block the dislocation motion without interrupting the migration of electrons.4 The mechanical property of TSV interconnection such as thermal behavior is important as well as the electrical property including electrical conductivity for improvement TSV performance. Therefore, the nanotwin Cu is proper for the TSV interconnection.

On the other hands, in the FOWLP process, the fabrication of the Cu Redistribution Layer (RDL) was one of main process for the FOWLP. Because of shrinkage of interconnection line width, RDL would be conducted by similar steps as conventional back-end processes: trench Cu filling and Chemical Mechanical Polishing (CMP) of overburden Cu layers during the Cu filling. However, CMP process caused an increase in process cost, therefore alternative methods are required.

Electrochemical Polishing was a process that makes surface of the conductive substrate smooth when it was anodically polarized in the electrochemical polishing solutions. Generally, electrochemical polishing of copper was conducted in phosphoric acid and it has been investigated from many researchers. Polishing effect can be observed within the potential range where the limiting current density plateau in the polarization curve. This method has advantages that simple and cost-effective method therefore it can be used for Cu removal replacing CMP method.