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Filling of Cu–Al Alloy Into Nanoscale Trench with High Aspect Ratio by Cyclic Metal Organic Chemical Vapor Deposition

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Feature size of Cu interconnects keep shrinking into several tens of nanometer level. For this reason, the Cu interconnects face challenging issues such as increase of electro-migration, line-width dependent electrical resistivity increase, and gap-filling difficulty in high aspect ratio structures. As the thickness of the Cu film decreases below 30 nm, the electrical resistivity is not any more constant, but rather exponential. Research on alloying with other elements have been started to inhibit such escalation in the electrical resistivity. A faint trace of Al added in Cu film by sputtering was reported to contribute to suppression of the increase of the electrical resistivity. From an industrial point of view, we introduced cyclic metal organic chemical vapor deposition (MOCVD) in order to control Al concentration in the Cu film more easily by controlling the delivery time ratio of Cu and Al precursors. The amount of alloying element could be lowered at level of below 1 at%. Process of the alloy formation was applied into gap-filling to evaluate the performance of the gap-filling. Voidless gap-filling even into high aspect ratio trenches was achieved. In-depth analysis will be discussed in detail.

Keywords: MOCVD, Cu interconnect, Alloy