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Cu films by partially ionized beam deposition for furture ULSI metallization

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In metallization for the future ultra large scale integration (ULSI), downward scaling of feature size is required. Because of reducing metallization line width and of elongating the line length, Al and Al alloys used in the current metallization have limitation of resistivity for application to the ULSI. In order to solve the limitations, Cu is a promising interconnection metal because of has low electrical resistivity as well as high electromigration resistance. In order to apply Cu to interconection material, it is important to fabricate Cu films with near bulk resistivity, thermal stability, via hole capability and good adhesion etc.

In this study, Cu films for ULSI metallization were fabricated by PIBD. Si (100) wafers were used as substrate and working pressure was 8×10^{-7} to 1×10^{-6} torr. Acceleration voltage and ionization potential were taken as deposition parameters. The Cu films showed that main peak came from (111) plane with small intensity of (200) plane. The degree of (111) preferred orientation greatly varied with deposition parameters. The PIBD showed excellent via filling characteristics to fill half-micron contact hole with aspect ratio of 3. The resistivity of the Cu films decreased with increasing Va and the minimum value was 1.94 $\mu\Omega$ cm. Electrical resistivity of the thin film higher was explained in terms of impurity concentration, grain size and surface scatttering. Especially, in order to investigate effects of surface roughness on resistivity, Cu films were irradiated with various Ar^+ ion dose by cold hollow cathode ion gun. Effects of rough surface on resistivity were discussed.