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Cu film growth on Si substrate by combining plasma enhanced chemical vapor deposition with partially ionized beam deposition

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Characteristics of growth mechanism in Cu films on Cu-seed layer were investigated. Cu-seed layer on Si substrate was deposited by partially ionized beam (PIB). In order to investigate the effect of Cu-seed layer on properties(growth rate, grain size and adhesion) of growing Cu films, Cu films were grown by plasma enhanced chemical vapor deposition (PECVD) on bare Si and on Cu-seed layer, respectively. Initial growth mechanism by PIB was investigate by transmission electron microscopy (TEM). TEM results show that stable islands on substrate were formed in fast way. The concentration of Cu nuclei was high even at the 1 sec. Deposition, and steady increase of the number of islands per unit are as deposition time increases at an initial stage of deposition. The growth rate of Cu films on Cu-seed layer is higher than that of Cu films on bare Si substrate. It might be considered that the fast formation of stable nuclei by PIB make incubation time in CVD deposition shorter, resulting in increasing the growth rate. The adhesion strengths and grain size of 250 nm Cu films with and without the Cu-seed layer were compared.