Electrical Characterization of Ultrathin Ag Films Deposited on Cu

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As the semiconductor industry continues to scale feature sizes, scattering from phonons, surfaces, and grain boundaries result in an increase of metal interconnect resistance. Although surface and grain boundary scattering are reported to be the dominating contributors to resistivity in the sub 32nm regime (1, 2), phonon scattering is still a significant portion of the total resistivity at room temperature and in recent years efforts have been made to reduce temperature dependent contributions to resistivity (3). In this work, the thermal coefficient of resistivity of ultra thin Ag films deposited on Cu is used as a measure of inelastic scattering due to electron-phonon coupling within the metal. Previous studies of the Ag Cu multilayer system showed that there is a relationship between the thickness of the Ag overlayer and the electron-phonon scattering parameter (4). It has been reported that there are critical thicknesses of Ag on Cu such that electron-phonon scattering is reduced up to thirty percent for Ag/V films (5).

In this work the thermal coefficient of resistivity is observed for various thicknesses of Ag deposited on Cu and compared to pure Cu films. An interdependence between Ag film thickness and the thermal coefficient of resistivity is observed for ultra-thin Ag films deposited on Cu. Also, a reduction in the rate of increase of the resistivity with respect to temperature is observed for all samples when compared to bare Cu films. A lower thermal coefficient of resistivity is indicative of a decreased contribution of the temperature dependent portion of resistivity to the total resistivity and may prove critical for the viability of future metallic conductor-based interconnect architectures.

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