Preparation and Characterization of Fiber Textured Copper Thin Films

Qiyin Lin

Laboratory for Electron and X-Ray Instrumentation
University of California, Irvine, Irvine, CA, 92697, USA

Copper (Cu) metal thin films are ubiquitous in microelectronic devices and have attracted considerable research due to its high electrical and thermal conductivity, good electromigration resistance and high melting point. Here, we report preparation and characterization of Cu thin films with thickness from ~50 to 500 nm that were deposited on silicon substrates in a high vacuum electron beam evaporation chamber interfaced with a thin film deposition controller. The surface morphology of Cu films were measured using high resolution scanning electron microscopy. Their structural properties were studied by various X-ray diffraction (XRD) and X-ray reflectivity techniques, including 3D pole figure, glazing incident scattering, out-of-pane and in-plane scattering. All films exhibit a (111)-fiber texture component along surface normal direction, which is consistent with the (111) surface energy minimization favored in films with FCC structure. The degree of fiber texture in these films increases with the film thickness. The refined lattice parameter a_o of 3.6148± 0.0005Å was determined by the high resolution XRD method. A thin oxide layer of Cu_2O was observed on the top of films by glazing incident XRD. The film layer thickness, density, and roughness were modeled and calculated by XRR method.