Deposition of Copper Particles and Films by the Displacement of Two Immiscible Supercritical Phases and Subsequent Reaction

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Copper (Cu) particles and films were deposited on native oxide of silicon (SiOx) and titanium nitride (TiN) by forming $Cu(hfac)_2 \bullet H_2O$ films on the substrates using a displacement from two immiscible supercritical phases (DISP) technique followed by reducing the $Cu(hfac)_2 \bullet H_2O$ films in hydrogen at 200 °C. Various reduction period frames ranging from 5-60 min and $Cu(hfac)_2 \bullet H_2O$ concentrations ranging from 0.5-3 wt% were used to examine initial nucleation and growth behavior and film formation mechanism of Cu DISP. At short reduction periods (5-15 min) or low $Cu(hfac)_2 \bullet H_2O$ concentrations (~ 0.5 wt%), Cu particles ranging 60 - 95 nm in diameter were produced. In contrast, at long reduction periods (45-60 min) and high concentrations (~ 3 wt%), Cu films with 220-450 nm in thickness were deposited on the substrates. It was found that nucleation of Cu DISP is not very sensitive to the surface conditions of the substrates. Chemical composition analysis of Cu films on TiN and SiOx by X-ray photoelectron spectroscopy (XPS) and secondary ion mass spectrometry (SIMS) revealed that highly pure Cu films were obtained from Cu DISP.