【S-15】

Transport Characteristics of Ultra-thin Cu Films Analyzed by in-situ ac Four-point Impedance Spectroscopy

박상윤,[1] 현영훈,[1] 이성준,[1] 이영백,[1] 이주열,[2]
[1]한양대학교 물리학과
[2]호서대학교 물리학과

Ultra-thin Cu film, with thicknesses of 3 Å ≦ d_{Cu} ≦ 90 Å, were deposited by electron-beam evaporation onto the glass substrate at room temperature. Measurements of the impedance spectroscopy and the resistance were simultaneously performed in-situ during the deposition. The impedance spectra were measured with four-point electrodes, in order to avoid the nonohmic characteristics of electrodes, and with a lock-in amplifier in a frequency range between 1 Hz and 100 kHz. In order to compare with the real-part impedance, the DC resistance according to the thickness was measured using an I-V source. We observed that the Cu film was in the percolation state at a thickness of 25 Å. The complex dielectric modulus of film could be described by a parallel R-C equivalent circuit when the film thickness is smaller than the percolation onset thickness. With the further growth of film, the complex impedance undergoes a transition to a inductive equivalent circuit at a thickness of 29 Å. A change in the relaxation time and the inductance of semicontinuous and continuous films are discussed by considering the roughness and grain-boundary scattering effects.