OR1904

Pulse induced modulation of electrical characteristics in ultrathin Molybdenum films

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Ultrathin molybdenum films were deposited on silica substrates by high power impulse magnetron sputtering (HiPIMS). The resistivity values obtained for 10 nm thick films are lower than that of the ones reported for highly conducting ultrathin copper or cobolt films. Even for the film with thickness of about 10 nm, a resistivity of 22.5 μΩ cm is obtained. Energetic impact of molybdenum ions on the depositing surface is a proven technique to obtain smooth and dense films with low roughness and low resistivity. Such characteristics could be attributed to higher nucleation density formed at the early stage of deposition and dense film growth during the deposition facilitated by the energetic impact Mo^{+1} or Mo^{+2} ions that dominates the composition of dense HiPIMS plasma. The results obtained here are greatly depend on the duty cycle of HiPIMS pulses, in particular the length of the pulses that are relative to origin and development of gas rarefaction during the HiPIMS discharge that controls the argon incorporation in molybdenum films. The obtained results are correlated to the model developed based on the scattering of charge carriers in grain boundaries.

Keywords
molybdenum film
energetic ion impact
gas rarefaction
Ar incorporation
low resistivity