OR0502

Nucleation and early growth of high-mobility films in pulsed deposition processes

Daniel Magnfält[1], Viktor Johansson[1], Gregory Abadias[2], Ulf Helmersson[1], Kostas Sarakinos[1]

[1]Linköping University, Linköping, Sweden [2]Université de Poitiers, Poitiers, France

danma@ifm.liu.se

Nucleation and early growth studies of Ag thin films deposited by high power impulse magnetron sputtering (HiPIMS) are presented. The evolution of internal film stresses and optical properties (by spectroscopic ellipsometry) are measured *in situ* which enables the monitoring of the onset and completion of film percolation in real time. *Ex situ* atomic force microscopy measurements are performed to elucidate the film morphology and surface roughness at the various stages of film growth (nucleation, coalescence and formation of a continuous film) while time- and energy-resolved mass spectrometry is used to determine the temporal evolution of the deposition flux. The films are deposited on Si(100) substrates covered by a native SiO_2 layer for a range of frequencies and pulse powers. It is found that the thickness at percolation decreases from 21 nm to 13 nm when the discharge frequency is varied between 50 and 1000 Hz for constant power pulses, while continuous deposition by direct current magnetron sputtering yield a constant percolation thickness of 16 nm in the same deposition rate interval. When the pulse power is varied from 20 mJ to 1.2 J at a constant frequency of 50 Hz the thickness at percolation is found to decrease from 21 nm to 13 nm. These results indicate that both the relatively high instantaneous deposition rates achieved during the pulse and the time-dependence of the deposition flux are decisive in influencing the early stages of thin film growth. We suggest that the modulation of the deposition flux that occurs in pulsed deposition processes allows for a large degree of control over the early stages of film growth where nucleation density, adatom diffusion times and energetics can be controlled as nearly independent variables.

Keywords
nucleation
pulsed deposition
HiPIMS
in situ diagnostics