Abstract

The tungsten nitride films were deposited on silicon substrate using Pulsed Laser Deposition (PLD) techniques. The effects of nitrogen gas pressure (0.5 to 2 Torr) and substrate temperature (room temperature to 300 °C) on surface, structural, electrical and mechanical properties of deposited films were investigated. The increase in kinetic energy (42 keV - 78 keV) and decrease in fluence (10×10^{11} ions/cm^2 - 5×10^{11} ions/cm^2) of tungsten plasma ions with the increase of nitrogen gas pressure were detected by Faraday cups technique. SEM analysis reveals that, the films deposited at room temperature under the lowest (0.5 Torr) nitrogen gas pressure have smooth surface topography with uniformly distributed spherical shape droplets. The increase in pressure and substrate temperature enhances the porosity and density of spherical shaped droplets. The X-ray diffraction analysis shows that as deposited tungsten nitride films are polycrystalline in nature. Initially the increase in pressure of N_2 up to 1.5 Torr enhances the growth of tungsten nitride phases whereas further increase of pressure up to 2 Torr is responsible for decrease in the crystallinity. The film deposited at room temperature is more favorable for growth of tungsten nitride phases as compared to higher temperature (100 °C to 300 °C). The electrical conductivity of tungsten nitride films has shown anomalous trend with the increase of nitrogen gas pressure. However, increase in temperature initially at 100 °C is responsible for slight increase in the electrical conductivity and then a decrease is observed with further increase of temperature up to 300 °C. The increase in film surface micro-hardness with the increase of pressure and substrate temperature is detected. However, the increase in surface hardness is more significant with temperature of 120% variation as compared to nitrogen gas pressure of 90%.