Abstract

The present research is motivated by the remarkable properties of hafnium nitride which includes chemical inertness, high thermal stability, high hardness and low electrical resistivity that have many applications ranging from coatings on cutting tools to diffusion barrier microelectronic applications. Formerly different techniques have been employed for hafnium nitride film coatings which are reactive magnetron sputtering, DC sputtering and radio-frequency reactive sputtering. However, there have been almost no studies to get hafnium nitride thin films deposition by dense plasma focus system. That is why the main purpose of the present work is to synthesize the hafnium nitride thin films at room temperature by using DPF system which produced high energy density pulsed plasma.

The coated samples are characterized for structural and morphological changes, compositional profile, electrical resistivity and surface hardness by employing X-ray diffraction (XRD) at GC University Lahore, scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDX) at GC University Lahore (CASP), four-point probe at GC University Lahore and nano-hardness test at PCSIR, Lahore.

Films were deposited with multiple numbers of focus shots, at 10 cm axial distance from top of the anode to substrate holder and at zero angular position with respect to anode axis. XRD patterns showed the growth of polycrystalline HfN thin films with orientations in the (111), (200), (220), (311) and (222) crystallographic planes. The crystallinity of HfN thin films was found to increase with increasing the number of focus shots. SEM results showed Smoother film along with elongated craters embedded in net-like structure was noticed for 25 focus shots. EDX analysis confirmed the presence of hafnium, nitrogen and silicon contents in deposited films. Also the content of hafnium and nitrogen increased as number of focus shots increased. As focus shots increased in number electrical resistivity of the deposited films decreased. Maximum hardness value achieved for 25 number of focus shots was 109.5 GPa.