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Mechanical properties of WNx films and their thermal stability

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The paper reports on the structure, microstructure, mechanical properties, oxidation resistance and thermal stability of the WN_x films; here x=N/W is the stoichiometry of nitride films. The films were reactively sputtered from a W target of diameter of 100 mm on Si(100) substrates in a mixture of $Ar+N_2$ gases using an unbalanced magnetron powered by the AC pulsed power supply. The properties of sputtered WN_x films were characterized by (i) X-ray diffraction (XRD), (ii) Scanning Electron Microscope (SEM), (iii) micro–indentation testing and (iv) ellipsometry. It was found that (1) the sputtered WN_x films are polycrystalline nanocomposites composed of a mixture (i) low–T α-W and high–T β-W_2N the phases at 0 lower than x lower than 0.6 and (ii) high–T β-W_2N and low–T δ-WN phases at 0.6 lower than x lower or equal than 1.5 and (2) the as-deposited WN_x films exhibit high values of the hardness H, ratio H/E^*, elastic recovery W_e increasing with increasing x up to 34 GPa, 0.13 and 88%, respectively; here $E^*=E/(1-u^2)$ is effective Young's modulus and u is Poison's ratio and (3) thermal annealing of WN_x at temperature of 500°C in air for 5.5 hours results in formation of WO_3 scale on the film surface with low values of H (4 to 5 GPa) and ratio H/E*=0.05.

Keywords
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