PO3032

Effect of nitrogen doping on mechanical and tribological properties of SiCxNy thin films

Jan Tomastik, Radim Ctvrtlik, Tomas Ingr

Palacky University, Olomouc, Czech Republic

tomastik@jointlab.upol.cz

Amorphous SiC coatings are the promising solution for a variety of functional coatings intended for harsh environment due to their superior high chemical stability and temperature resistance. Despite the vast application potential of SiC, its structural applications are limited by its brittleness. The possible solution to overcome this drawback may be an introduction of nitrogen atoms into its structure. Besides, it allows tailoring of its electrical and optical properties.
The magnetron-sputtered a-SiCxNy coatings with various N content (0-40 at.%) deposited on silicon substrates were evaluated in this study at room temperature and after exposure to high temperatures of 700, 900 and 1100 °C in oxidizing air environment. Additional 900 °C annealing in vacuum was performed to distinguish influences of different thermally induced mechanisms (oxidation vs. short range ordering). Composition and structure was explored using of variety analytical techniques (XRD, Raman and IR spectroscopy, SEM, GDOES). Mechanical properties evaluation was performed using nanoindentation, while tribological properties were assessed using scratch test method. Traditional techniques of scratch test evaluation (the depth change record and the microscopic observation) were expanded by the detection of acoustic emissions during scratch tests. The detection system of our own design allows simultaneous acoustic emission record at the high resolution, which significantly increased the reliability and accuracy of the scratch test evaluation.
Results show the beneficial effect of the nitrogen doping on the tribo-mechanical performance of resulting a-SiC_xN_y coatings. The improved fracture resistance of the SiCN films stems from the suppression of SiC clusters crystallization. Exposure to the elevated temperature led to the more pronounced oxidation of SiCN in comparison to the pure SiC sample. The formation of SiO_x oxide film resulted to the better scratch test results.

Keywords
silicon carbonitride
nanoindentation
scratch test
high temperature coatings
acoustic emission