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Study of the thermal stability of MoBC coatings

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Recently, there has been an increased interest in boron and carbon based nanolaminates which favorably combine the properties attributed to ceramics and metals. The Mo_2BC thin films show a combination of high stiffness, hardness and elastic modulus together with moderate ductility to reduce cracking. Our previous experimental work proved the presence of superior fracture toughness combined with high hardness of about 30 GPa and low surface roughness. In this study we focused on the thermal evolution of this mechanical properties and surface roughness upon annealing. For the preparation process the DC magnetron sputtering was used and the deposition was carried out on hardmetal, steel and silicon substrates.
In the area of research concerning thermal stability of materials, there are lots of studies that discuss the thermal properties of Mo-C and Mo-B systems, however, none of them investigates the thermal stability of nanolaminated Mo-B-C system. In this study, two different types of structures of the MoBC coatings were investigated – the amorphous coating with hardness of about 20 GPa and coatings with nanocrystalline structure where the typical hardness value is around 30 GPa. The coatings with the exact stoichiometry of Mo_2BC as well as coatings out of this perfect stoichiometry are present and discussed. The thermal annealing was studied using thermal desorption spectroscopy and the mechanical properties were analyzed as functions of final annealing temperatures. The hardness and elastic modulus were measured and evaluated by depth sensing nanoindentation technique performed on Hysitron TI950 Triboindenter equipped with a Berkovich tip. The fracture toughness were evaluated by scanning electron microscope. The results of mechanical testing were correlated with microstructure observations carried out on MIRA 3 FEGxSEM which was used mainly for observation of cracking inside residual imprints.

Keywords
thermal annealing
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