MICROMECHANICAL TESTING OF Mo-B-C LAYERS PREPARED BY MAGNETRON SPUTTERING

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Key Words: magnetron sputtering, layer, microstructure, micropillar, micromechanical testing

Based on attractive mechanical properties of transition metal diborides the group of X_2BC ternary compounds (X = Ti, V, Zr, Nb, Mo, Hf, Ta and W) became subject of theoretical calculations [1-3] and lately proved their applicability experimentally [4]. X_2BC with X = Mo, Ta and W are the most promising candidates for protection of cutting and forming tools due to their unusually stiffness and moderately ductility. These properties can be understood by considering the electronic structure and particularly the extreme anisotropy (orthorhombic crystal lattice with a=0.309nm, b=1.735nm, c=0.305nm).

In this work we focus on nanostructured Mo-B-C layers (2-3 μm thick) grown on hard metal or steel substrates by DC magnetron sputtering of three targets: B_4C, Mo and C. Elastic modulus (430±10 GPa) and indentation hardness (28±3 GPa) data of Mo-B-C layers were obtained by means of indentation tests using a diamond Berkovich indenter with tip radius less than 50nm. Micropillars were prepared using focused ion beam (FIB) technique in a Tescan LYRA 3XMU SEM×FIB scanning electron microscope (SEM), see Fig. 1. Micromechanical testing of pillars was done in a Hysitron TI950 triboindenter using a flat diamond indenter (diameter of about 10 μm). The relations between the obtained results were evaluated and discussed. Thin lamellas were prepared both from indented parts of layers and from deformed pillars along compression axis and microstructure was observed in a Philips CM12 STEM transmission electron microscope (TEM) and a JEOL 2100F high resolution TEM.

The research has been supported by The Czech Science Foundation (Project 15-17875S).

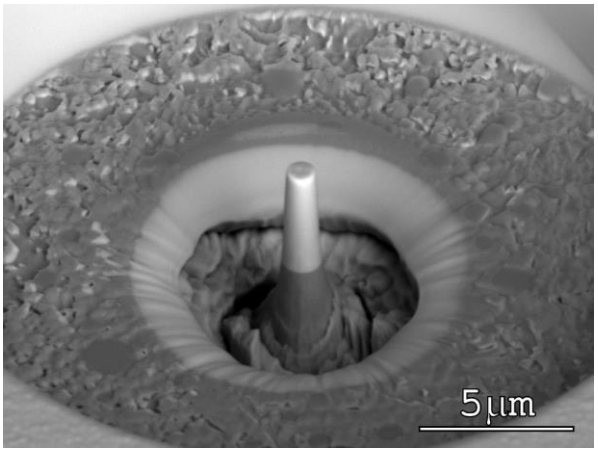

Figure 1: SEM micrograph of a pillar prepared by FIB from Mo-B-C layer on a steel substrate.

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