OR1002

Ductile behavior of hard partially crystalline Mo2BC nanolaminate

Petr Vasina[1], Pavel Soucek[1], Vilma Bursikova[1], Lukas Zabransky[1], Jiri Bursik[2], Vratislav Perina[3]

[1]Masaryk University, Brno, Czech Republic [2]Institute of Physics of Materials, Academy of Sciences of the Czech Republic, Brno, Czech Republic [3]Nuclear Physics Institute, Academy of Sciences of the Czech Republic, Rez, Czech Republic

vasina@physics.muni.cz

State-of-art ceramic materials nowadays used as protective coatings such as TiN, TiAlN, c-BN etc. generally exhibit high hardness and high stiffness. These positive features are often accompanied by negative brittle deformation behaviour. To overcome this limitation a new generation of materials with high hardness and moderate ductility is desired. Recently, there has been an increased interest in boron and carbon based nanolaminates such as Mo_2BC which exhibit a very similar structure to the MAX phases. In our research, co-sputtering of Mo, C and B_4C targets to finely tune the coating composition was used. Mid-frequency pulsed DC plasma excitation was employed to enhance the ion flux on the substrate by factor of 3 compared to DCMS case which promoted the crystallization of Mo_2BC. Coatings with the same XRD patterns as those deposited by HiPIMS at the same substrate temperature were prepared. The moderate deposition conditions resulted in grown of partially crystalline Mo_2BC coatings with nanocomposite structure where small Mo_2BC crystallites of approx. 10 nm size were embedded in an amorphous matrix. These coatings showed high hardness of 31.6 ± 0.8 GPa and extremely high fracture toughness – it was even impossible to form a crack in these coatings at extremely high indentation load with cube corner indenter where both the coatings and the underlying hard-metal substrate were severely plastically deformed. Only a shear/slip plane defects typical for ductile materials were detected. This required ductile behavior of hard coating observe for partially crystallite Mo_2BC with nanocomposite structure is hard to be met with other commercial coatings tested by similar manner.

Keywords
PVD
fracture toughness
nanolaminate
protective coating
ductility