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Ductile behavior of hard MoBC and WBC nano laminated coatings

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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 behavior. 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. According to the ab-initio models, these materials were predicted to exhibit unusual combination of high stiffness and moderate ductility. The coatings were deposited either by DCMS at extremely high substrate temperature of 900°C or at moderate temperature of 380°C employing HiPIMS. In our research, co-sputtering of Mo (W), C and B_4C targets to finely tune the coating composition of Mo_2BC and W_2BC was used. Mid-frequency pulsed DC plasma excitation was employed to enhance the ion flux on the substrate by factor of three 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 growth of partially crystalline Mo_2BC coatings with nano composite structure where small Mo_2BC crystallites of approx. 10 nm sizes 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 observed for partially crystallite Mo_2BC with nano composite structure .

Biography

Petr Vasina completed his PhD in 2005 at Université Paris-Sud in discipline Waves and Matter and at Masaryk University in discipline Plasma Physics. He works at Masaryk University, Brno, Czech Republic. He is a Senior Researcher; a Group Leader at CEPLANT Research Center; Associate Professor and; Deputy Director of Department of Physical Electronics, Faculty of Sciences. His primary research areas are "Study of elementary processes in discharges, diagnostics and modeling of reactive plasmas, study and development of deposition processes and their application for thin film deposition, high power impulse magnetron sputtering and deposition of nanostructured composite materials". He has published more than 40 peer-reviewed papers and he is a Co-inventor of a patent.

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