The methods of deposition of transition metal borides coatings with improved mechanical and thermal properties

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Abstract: In recent years, the search for improved materials for green energy, aerospace and automotive has been the focus of interest of scientists and industry. As an example transition metal borides such us ZrB_2, TiB_2, WB_2 can be mentioned with their extraordinary thermal, mechanical properties and oxidation resistance even above 500˚C. Also in the form of thin films they are competitive with commercially used nitrides. The last studies have been show that disadvantages like low fracture toughness can be improved by alloying them with other transition metals TM= Ti, Cr, Zr, Mo, Ta, Hf etc. or the choosing of suitable deposition method. In this work the doping of tungsten diboride with titanium is presented. Also, two different method of deposition like High-Power Impulse Magnetron Sputtering (HiPIMS) and hybrid PLD-MS, which give possibility to produce a plasma with the higher energy than conventional DC magnetron sputtering are studied. Such solution allows to obtain coatings which are very hard and fracture resistant simultaneously. Deposited by HIPIMS coatings are smooth and possess lower hardness (40 GPa) than films deposited with PLD-MS method (51±8 GPa). However produced by hybrid method films are rougher and are characterized by higher Young modulus (520 GPa vs. 354 GPa) what cause that they are characterized by lower fracture resistance. Additionally, HIPIMS crystalline films can be obtained in 300˚C (520˚C for PLD-MS) what increase possibility of their future application. I should be noted that tungsten borides have very high potential for its implementation as a wear protecting coatings on tools and also in nuclear energy solutions.

Keywords: magnetron sputtering**,** transition metal borides, protective coatings

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