Poster Session: BP-ThP-1

Superhard tungsten-tantalum diboride (W,Ta)B2 coatings prepared by High power impulse magnetron sputtering HiPIMS

Rafał Psiuk[1], Piotr Denis[1], Łukasz Kurpaska[2], Tomasz Mościcki[1]

[1]Institute of Fundamental Technological Research PAS, Warsaw, Poland
[2]National Centre for Nuclear Research, Świerk, Poland

Modern industry requires highly wear-resistant materials in many applications. Some demands can only be met by superhard materials. While diamond and cubic boron nitride are very popular in many areas of industry they possess also major drawbacks – high pressure during synthesis or affinity to iron. Superhard tungsten borides may be alternative to traditional superhard materials in many applications. They are superhard, have good thermal and chemical stability. They are also thermally and electrically conductive. Additionally they do not require high pressures during synthesis and their properties can be enhanced by alloying with transition metals, like titanium[1], zirconium[2], and others.

High power impulse magnetron sputtering was successfully recognised by industry. Because of high ionization during the process this technique can produce high quality, dense materials with comparatively low substrate temperatures. Studies on tungsten borides prepared by HiPIMS have been already done by researchers.

In this work we present deposition and characterization of tungsten-tantalum diboride (W,Ta)B2 coatings prepared by HiPIMS. We evaluated the influence of pulse duration, substrate temperature and substrate bias on properties of (W,Ta)B2 films. Crystalline structure was obtained at 250°C. High hardness above 40 GPa measured by nanoindentation was obtained simultaneously with good adhesion to steel substrates evaluated by scratch-test. Changing the pulse duration highly affected the B/(W+Ta) ratio which had influence on properties of coatings. Deposited films was thermally stable up to 1000°C in vacuum, and was able to withstand oxidation in 500°C

[1] Mościcki T., Psiuk R., Słomińska H., Levintant-Zayonts N., Garbiec D., Pisarek M., Bazarnik P., Nosewicz S., Chrzanowska-Giżyńska J., Influence of overstoichiometric boron and titanium addition on the properties of RF magnetron sputtered tungsten borides, SURFACE AND COATINGS TECHNOLOGY, 2020

[2] Garbiec D., Wiśniewska M., Psiuk R., Denis P., Levintant-Zayonts N., Leshchynsky V., Rubach R., Mościcki T., Zirconium alloyed tungsten borides synthesized by spark plasma sintering, ARCHIVES OF CIVIL AND MECHANICAL ENGINEERING, 2021

This work was financed by the National Centre for Research and Development (NCBR, Poland) under project no. TECHMATSTRATEGIII/0017/2019.