FEMS EUROMAT 2015

European Congress and Exhibition on Advanced Materials and Processes

WARSAW 20–24 September 2015

Final Program

WARSAW UNIVERSITY OF TECHNOLOGY

EURO MAT 2015

EUROMAT 2015 is tightly connected with E-MRS Fall Meeting 2015 (15-18 Sept.), organised by E-MRS and "Materials Weekend" (19-20 Sept.), organised jointly by E-MRS and FEMS under the auspice of EMF

www.euromat2015.fems.org

Radiofrequency assisted pulsed laser deposition of WBN and ReBN thin films

JUSTYNA CHRZANOWSKA[1]*, TOMASZ MOSCICKI[1], JACEK HOFFMAN[1], DARIUSZ GARBIEC[2]

[1]Institute of Fundamental Technological Research, Pawinskiego 5B, 02-106 Warsaw, Poland
[2]Metal Forming Institute, Jana Pawła II nr 14, 61-139 Poznan, Poland
* Corresponding Author E-mail: jchrzan@ippt.gov.pl; telephone: +48 22 826 12 81 ext. 236

The tungsten-boron-nitride system is a promising composite which exhibits high melting point and hardness, coupled with lower friction [1]. Till now there is no information about rhenium-boron-nitride composite, which similarly to WBN may have great application potential. On the base of triple phase diagrams [2] both of these composites should be the mixtures of hard or superhard materials (WB_2 + WB_4 + BN or ReB_2 + BN respectively) when boron atoms is above 70 percent.

In this work WBN and ReBN thin films have been deposited by radiofrequency assisted pulsed laser ablation (RF-PLD) starting from a SPS sintered $ReB_{2.5}$ and $WB_{2.5}$ targets in nitrogen atmosphere. The effect of reactive atmosphere of N on the microstructure, mechanical properties, has been studied. The deposited films were characterized by X-ray diffraction, scanning electron microscope + EDS, optical profilometer, and Vickers microhardness technique. The amorphous structure and mocrohardness greater than 30 GPa for both films was measured.

Acknowledgements

This work was supported by the National Science Centre (Poland). Research Project: UMO-2012/05/D/ST8/03052

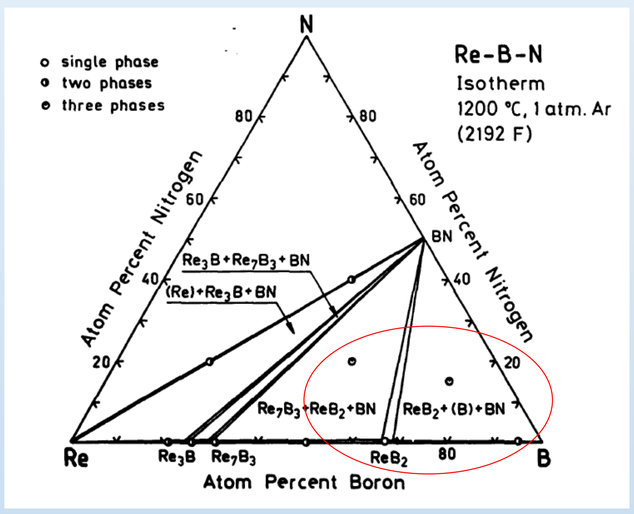
[1] Lihua Yu, Hongjian Zhao, Junhua Xu (2014) “Mechanical, tribological and corrosion performance of WBN composite films deposited by reactive magnetron sputtering”, Applied Surface Science 315, 380–386.
[2] Peter Roql , Julius Clemens Schuster (1992) “Phase diagrams of ternary boron nitride and silicon nitride systems”, ASM International, Materials Park.

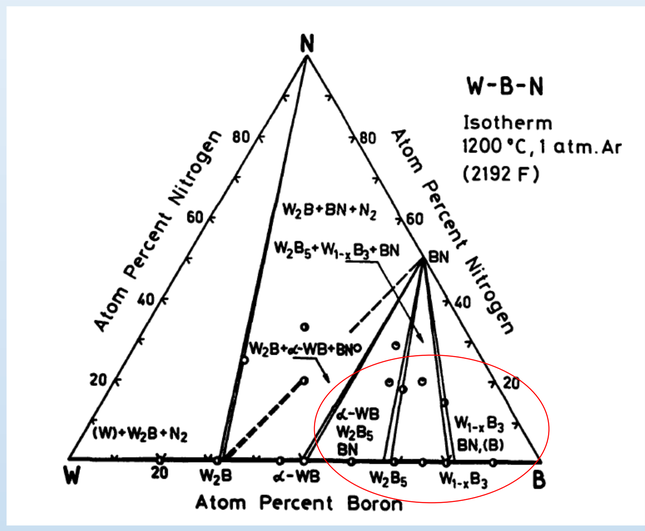
Radiofrequency assisted pulsed laser deposition of WBN and ReBN thin films

JUSTYNA CHRZANOWSKA[1]*, TOMASZ MOSCICKI[1], JACEK HOFFMAN[1], DARIUSZ GARBIEC[2]

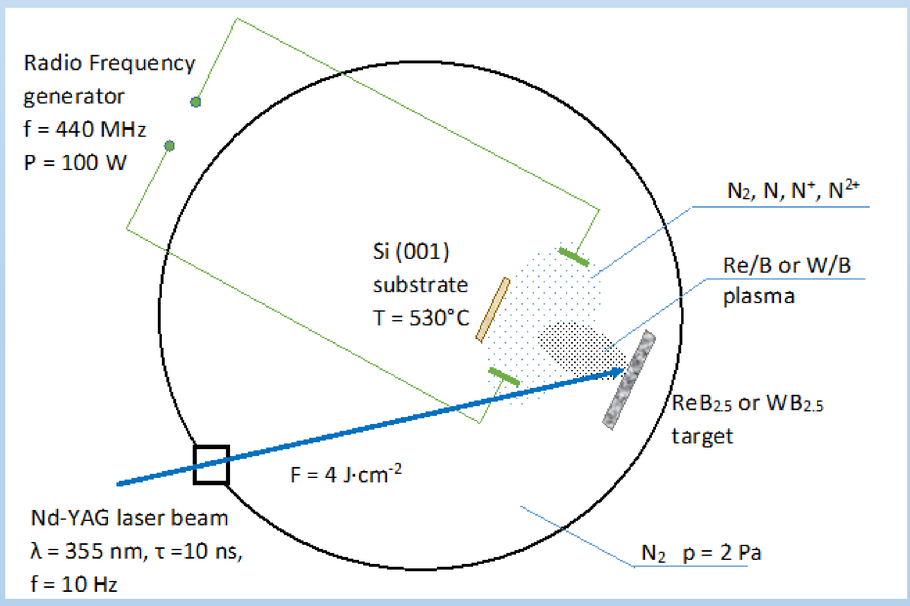
[1]Institute of Fundamental Technological Research, Pawinskiego 5B, 02-106 Warsaw, Poland
[2]Metal Forming Institute, Jana Pawła II nr 14, 61-139 Poznan, Poland
* Corresponding Author E-mail: jchrzan@ippt.gov.pl; telephone: +48 22 826 12 81 ext. 236

The tungsten-boron-nitride system is a promising composite which exhibits high melting point and hardness, coupled with low friction. Till now there is no information about rhenium-boron-nitride composite, which similarly to WBN may have great application potential. On the base of triple phase diagrams both of these composites should be the mixtures of hard or superhard materials (WB2 + WB4 + BN or ReB2 + BN respectively) when boron atoms is above 70 percent.



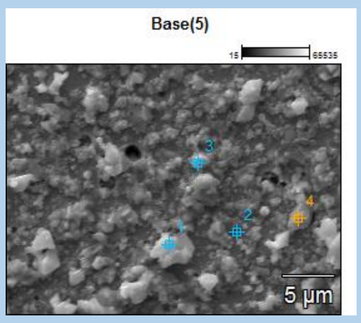


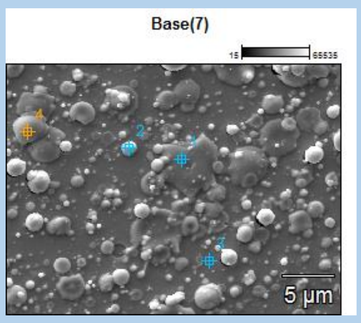
WBN and ReBN thin films have been deposited by radiofrequency assisted pulsed laser ablation (RF-PLD) starting from a SPS sintered ReB2.5 and WB2.5 targets in nitrogen atmosphere. Experimental setup is shown below.

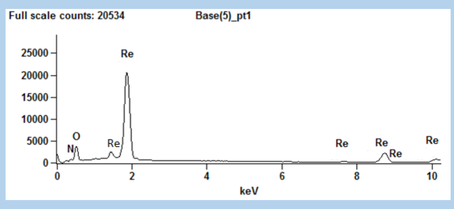


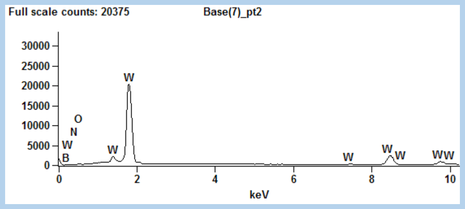
SEM + EDS

ReBN WBN





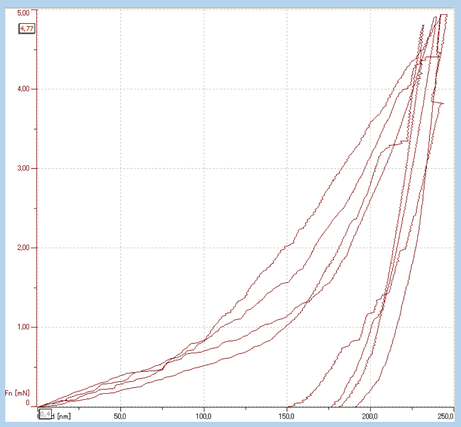


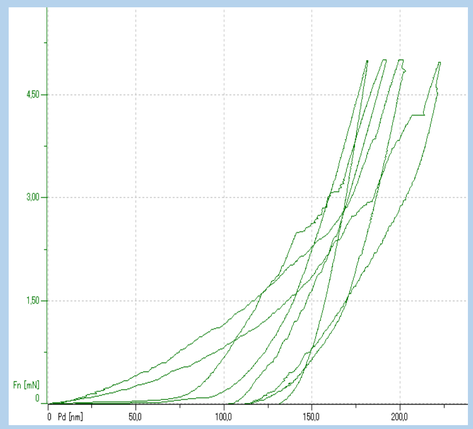


ReBN and WBN layers were characterized by low nitrogen content. The ReBN layers have low density and irregular structures on the layers surface. The WBN layers are dense but are composed mainly by droplets.

Nanoindentation

ReBN WBN

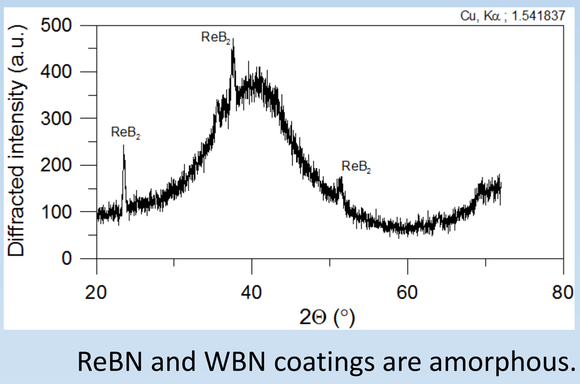




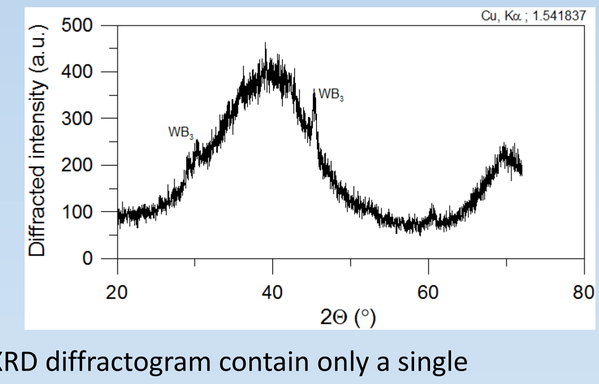
Results of Vickers hardness of ReBN sample (a) 5685.6 MPa and WBN sample (b) 9004.3 MPa,

XRD

ReBN



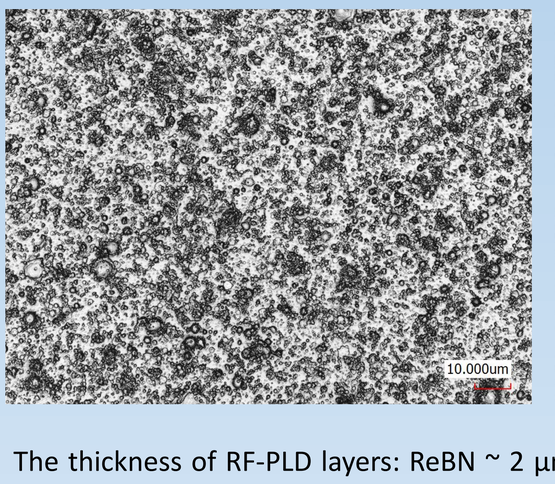
WBN

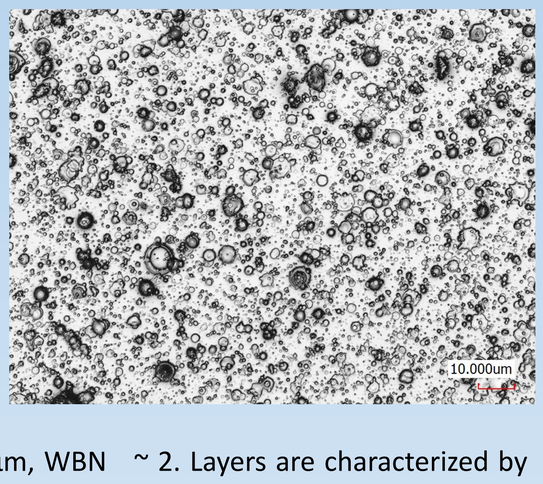


ReBN and WBN coatings are amorphous. XRD diffractogram contain only a single peaks from the crystalline phase.

Optical microscope

ReBN WBN





The thickness of RF-PLD layers: ReBN ~ 2 µm, WBN ~ 2. Layers are characterized by high roughness but no delamination were observed.

Conclusions

In the synthesis of ReBN and WBN coatings the method of RF-PLD was used for the first time. It is clearly show that due to the high roughness and low nitrogen content in the deposited layers the deposition parameters should be improved. It is necessary to conduct further studies involving a change of both the RF and PLD parameters.

Acknowledgement: This work was supported by the National Science Centre (Poland). Research Project: UMO-2012/05/D/ST8/03052