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Book of Abstracts

Comparison of tungsten boride layers deposited by laser pulse, magnetron sputtering and combined magnetron sputtering- pulsed laser deposition

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Tungsten borides belong to the group of hard and superhard materials. Depending on the chemical and phase structure its hardness varies from about 20 to 40 GPa [1]. Moreover, the hardness of this group of materials can be increased by the design of the microstructure for example in the processes of physical vapour deposition like pulsed laser deposition (PLD) [2,3] or magnetron sputtering (MS) [4,5]. In this work the properties of tungsten boride layers deposited by laser pulse, magnetron sputtering and combined MS- PLD method is analysed. Moreover, for all deposition methods the transfer of target stoichiometry to the layer will be analysed.

In PLD and MS deposition the target composed of tungsten and boron mixed in a molar ratio of 1:4.5 was used. In combined MS-PLD process two kinds of target were used: pure tungsten (evaporated by laser beam) and pure boron (sputtered by magnetron). During the PLD process the Nd: YAG laser ($\lambda = 355 \text{ nm}$, $\tau = 10 \text{ ns}$, fluence = $4.8 \text{ J} \cdot \text{cm}^{-2}$, $f = 10 \text{ Hz}$) was used. The laser beam was at an angle of 45° to the target surface and was focused to a spot size of 3.5 mm^2 . Magnetron sputtering was realized by sputtering cathode with RF power supply. The MS process occurred in argon pressure of $9.8 \cdot 10^{-3} \text{ mbar}$ (gas flow of argon was 19.2 mL/min). The target to substrate distance in both PLD and MS processes was 40 mm and substrate temperature was $540 \text{ }^\circ\text{C}$. In combined MS-PLD process the experimental set-up was fixed as presented in fig. 1.

Layers deposited in different processes were quite different. PLD layers were rough and on its surface were many droplets of micrometre size (fig 1 (b)), while MS layers were very smooth and homogeneous (fig. 1 (c)). On the basis of XRD spectrum it was stated that PLD layers were composed of hexagonal WB_3 and MS layers were composed of tetragonal WB. Combined MS-PLD process allows to obtain different chemical and phase structures of tungsten borides.

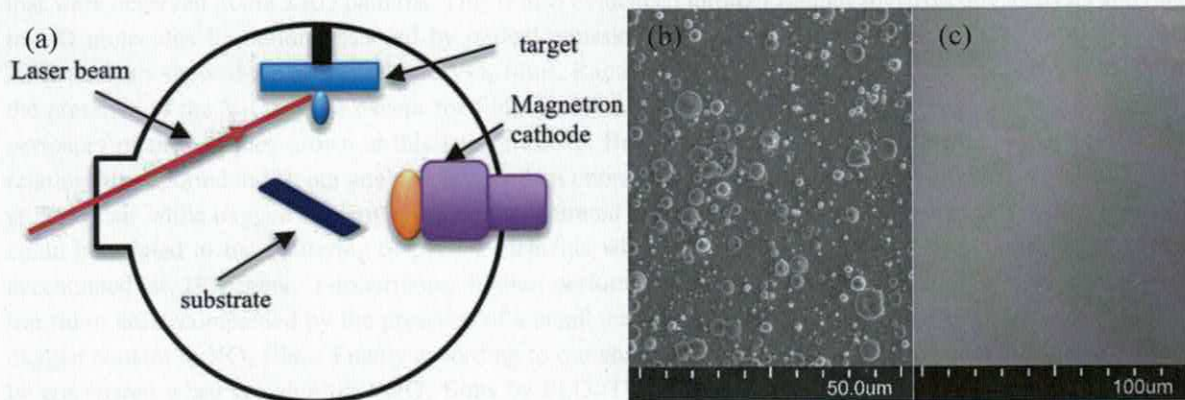


Fig. 1. (a) Experimental set up in combined MS-PLD deposition, (b) layer deposited in PLD process, (c) layer deposited in MS process.

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