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Thin WB_x and $W_xTi_{1-x}B_2$ films deposited by combined magnetron sputtering and pulsed laser deposition technique

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The development of high-speed tools requires materials having high hardness, good chemical and thermal stability. Diamond and cubic boron nitride are the hardest materials currently used, but still, they have some drawbacks like the requirement of the high temperature-high pressure conditions during the synthesis process. Therefore, the topic of new superhard materials is still under the consideration of scientists. One of the materials considered to be superhard are compounds of transition metals and light elements like B, N, O, C. Among such materials, tungsten borides are known for high hardness [1] and wear resistance [2], and their properties change significantly depending on the chemical and phase composition.

In this paper, the results of WB_x and $W_xTi_{1-x}B_2$ films deposited by combined magnetron sputtering and pulsed laser deposition technique are presented. The experimental setup is presented in Fig. 1. In the case of WB_x films, pure boron target was sputtered by the magnetron, and pure tungsten target was ablated by laser impulse, and in the case of $W_xTi_{1-x}B_2$ films, the W_2B_5 target was sputtered by the magnetron, and the TiB_2 target was ablated by laser impulse. The deposited films have a high hardness exceeding 40 GPa. The chemical composition of deposited films was adjusted by sputtering power and laser fluence, and the Ti dopping supported the formation of boron-rich phases. Moreover, the effect of substrate temperature in the range from 23 °C to 700 °C was investigated.

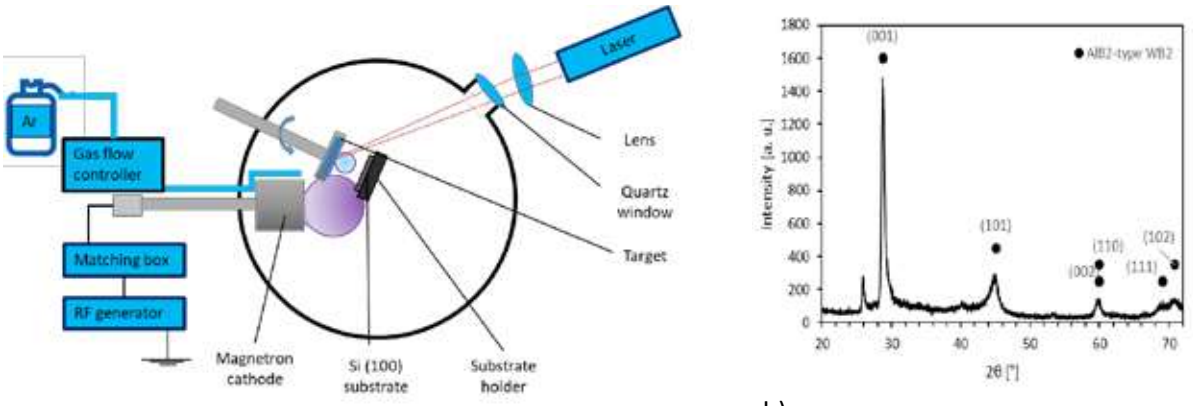

Fig. 1 (a) The experimental setup. (b) An example of the XRD pattern of the deposited film.

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