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BOOK OF ABSTRACTS

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Formation of WB_4 thin films using nanosecond Nd-YAG laser

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In many manufacturing processes, materials must be cut, formed, or drilled, and their surfaces protected with wear-resistant coatings. For mentioned application tungsten tetraboride WB_4 is one of the most promising candidates for the ultra-incompressible, super-hard and inexpensive material [1-3]. Even in the form of thin films it has super-hard properties [4] and in the future may be an alternative to other hard coatings for example diamond-like DLC or cubic boron nitride (c-BN). One of the most promising methods of obtaining WB_4 films is pulsed laser deposition (PLD) because it suits very well for deposition of hardly meltable materials as W and B. The beam intensity of a conventional Nd:YAG laser at the focal spot on the target is easily in the range of GW/cm^2, which means that the laser can evaporate any known material. One of the usually mentioned advantages of this method is that stoichiometry is preserved. WB_4 films have been deposited on Si (100), by PLD technique using nanosecond, Nd:YAG laser working at 355 nm (54000 laser pulses at 10 Hz repetition). The laser fluence was about 6 J/cm^2 and the substrate temperature was 570°C. Additionally the surface of SPS sintered WB_x target before and after ablation process was examined. WB_2 to WB_4 phase change at the surface of target is observed. The phase analysis, crystallography and orientations have been studied using X-ray diffractometry. The surface layer after ablation and deposition film are found to be mostly crystalline WB_4 (Fig.1). The surface topography and chemical composition have been measured using scanning profilometer, SEM and EDS respectively. The profilometer measurements show about 1 µm thickness of deposited films (Fig.2). The deposited film (Fig.2,3) and surface layer after ablation are rugged. The SEM with EDS measurements indicated that both films have stoichiometric composition similar to theoretical. The micro indentation test indicate that both films are very hard H_v>30GPa (Fig.4).

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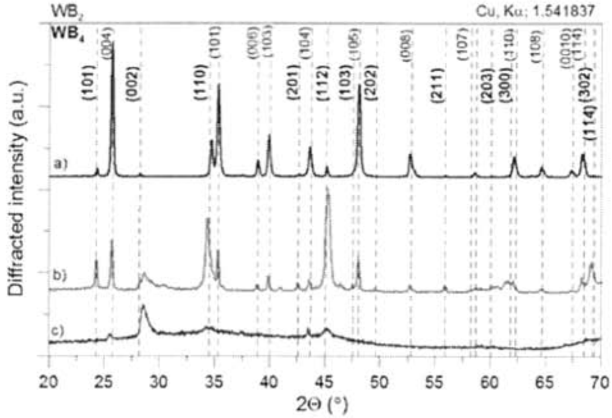

Fig. 1: X-ray diffraction pattern of (a) target; (b) target surface layer after ablation, (c) deposited film

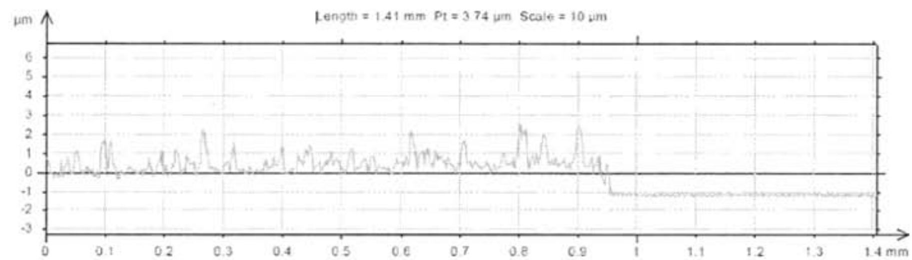

Fig. 2: The profile of surface of deposited WB_4 film.

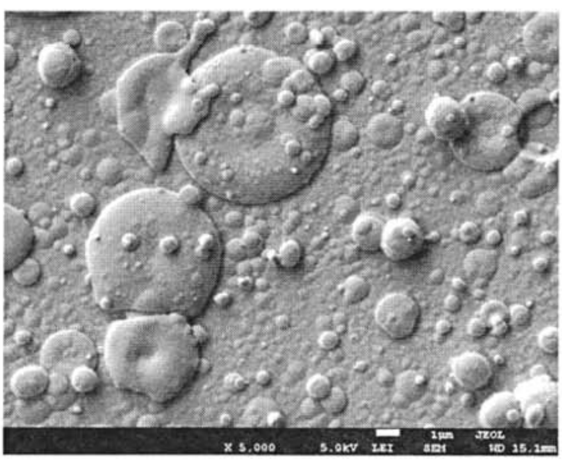

Fig. 3: SEM micrograph of WB4 film after deposition (magnification ×5000)

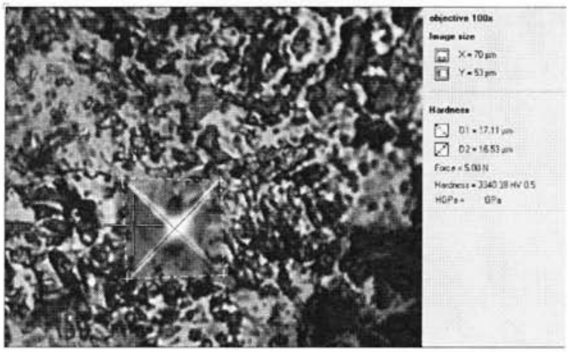

Fig. 4: Vickers microhardness of WB_x target (force 5N, H_v=32,75 GPa)