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Analysis of adhesive properties of B2 hardmetal surface

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Hardmetals belong to hardly wettable materials, so they should not be bonded without previous removing the surface layer left after sintering. The paper describes mechanical and chemical methods of preparing hardmetal surface for such processes as gluing and brazing. Particular attention is paid to the method of electrolytic etching that offers very good energetic properties of hardly wettable materials. In order to analyse the surface adhesive properties of hardmetals, measurements of roughness and wetting angle were performed, as well as electron microscopic examination and EDX analysis.

Keywords: *hardmetals, adhesion, surface preparation, roughness measurements, wetting measurements, EDX analysis*

1. Hardmetals used in the research

The hardmetal grade B2 (acc. to PN-H-89500:1988) were selected for the research, characterised by most advantageous abrasion resistance-to-ductility ratio, coarse-grained structure with uniformly distributed cobalt and absence of additional phases. Size of the WC grains (α phase) ranged basically from 1 to 7 μm, but also some grains up to 12 μm and single grains up to 15 μm happened. Examination of fracture surfaces did not reveal macroscopic pores or other material discontinuities. Microscopic investigations revealed minimum gaseous porosity (pores up to 10 μm) of the examined plates, which did not impair their quality.

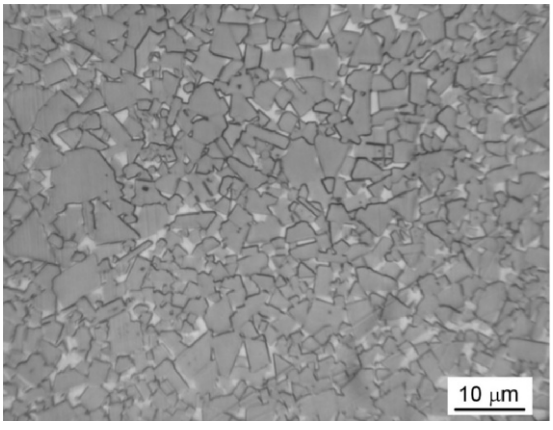

Fig. 1. Microstructure of hardmetals grade B2

Chemical analysis of the examined plates revealed cobalt content 9.3 wt.%. Chemical composition of the hardmetals is given in Table 1 and their physicochemical and mechanical properties are given in Table 2.

Table 1. Chemical composition of the examined hardmetals B2

Co	Ni	Ti	Ta	Nb	WC
9.3	0.006	max. 0.01	max. 0.01	max. 0.01	rem.

Table 2. Properties of the examined hardmetals B2

Density ρ, kg/m^3	$14.64 \cdot 10^3$
Hardness HV30	1220
Bending strength R_g, MPa	2300
Tungsten dissolved in Co, wt%	9.6

Microstructure of the B2 hardmetals is shown in Figure 1.

2. Methodology for preparing hardmetal surface

A very important factor affecting usable properties of a joint is proper preparation of the surfaces to be bonded, especially in the case of hardly wettable materials. This particularly concerns hardmetals, which after the sintering process should not be bonded without removing the surface layer. Their surface preparation often consists in applying metallic layers (in chemical/physical way or with plasma) [1−5]. Although the hardmetals are hardly workable by abrasive machining [6], in industrial practice they are usually subject to mechanical grinding. This is the reason why this method was chosen as one of the ways of hardmetal plate surface preparation.

Considering a possibility of significant surface development, abrasive blasting using alundum 99A with granulation 0.8 to 1.2 mm was selected as the next method of hardmetal surface preparation. This operation increases surface development. However, before this machining, the hardmetal preforms should be degreased to avoid introducing impurities into tiny pores and surface irregularities, as well as to prevent the abrasive agent from being soiled with grease. With respect to possible small quantities of oil in compressed air, the prepared surfaces were degreased once again after abrasive blasting [4]. This permitted removing dust and, at the same time, residues of the used abrasive. Roughness of the machined surface can be controlled by proper selection of grain size, angle and direction of the abrasive stream. To secure repeatability of the results, duration of the surface preparation by abrasive blasting was always 30 seconds and the distance of the blast nozzle directed perpendicularly to the specimen surface was 100 mm.

Chemical or electrochemical etching usually allows developing the surfaces of the materials to be bonded. A particular method of preparing hardmetal surface for bonding processes is electrolytic etching that consists in anodic dissolution of tungsten car-

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