

Silicides as a Bonding Phase for Diamond Compacts

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The Mo_5Si_3 , MoSi_2 , NbSi_2 , TaSi_2 were produced from stoichiometric mixtures of powders using SHS method. The SHS product was milled to powder of a specific surface area close to $10 \text{ m}^2/\text{g}$. Next the powdered silicides were mixed with diamond powders of 3-6 μm (MDA, De Beers) in a Turbula mixer for one hour. Diamond compacts were prepared. Sintering of the diamond composites were carried out using HT-HP Bridgman type apparatus at $1800 \pm 50^\circ\text{C}$ and under a pressure of $8 \pm 0.2 \text{ GPa}$. The phase composition and microstructure of SHS powders and PCD were studied using X-ray diffractometry and transmission electron microscopy. They showed that even as most of phase composition of SHS powders corresponded to the stoichiometry of mixtures of elementary powders, in the MoSi_2 -SHS reaction, a product with up to 6 vol.% of Mo_5Si_3 was detected, and in the Mo_5Si_3 -SHS reaction, a product with about 6 vol.% of MoSi_2 was present. In the NbSi_2 -SHS reaction, the presence of $\sim 33.5 \text{ vol.}\%$ of Nb_5Si_3 was detected. The X-ray measurements and electron diffraction analysis of PCD prepared with such binding materials showed that, as a result of reactions between carbon and elements of a bonding phase, a new carbon phase appeared in the compacts. The Young's modulus measurements performed using ultrasonic method indicated that all prepared compacts had similar modulus within the range from 325 to 348 GPa. Vickers hardness of tested compacts showed much higher differences, namely $39.5 \pm 3.1 \text{ GPa}$, $26.4 \pm 1.0 \text{ GPa}$, $44.5 \pm 1.8 \text{ GPa}$, for composites with binding material containing predominantly MoSi_2 , Mo_5Si_3 , NbSi_2 , respectively.