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PRODUCTION OF TiB_2-$MoSi_2$-BASED CERAMICS IN CONDITIONS OF SHORT-TERM ELECTRIC CURRENT

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The composite materials based on titanium diboride are the focus of intensive research, given their high physical and mechanical, tribotechnical characteristics and the possibility of operation at high temperatures in an aggressive environment. One of the most studied composites is the materials of the TiB_2 – $MoSi_2$ system. Sufficient content of molybdenum disilicide in composite powder of composition TiB2 – 20% (wt.) $MoSi_2$ puts its level of electrical conductivity between copper and iron. Due to this, its composition is the most promising for Spark Plasma Sintering (SPS) technology.

In the framework of the research, composite powders with a composition of TiB_2 – 20% (wt.) $MoSi_2$ were used, which were obtained by mechanosynthesis at the Institute for Problems of Materials Sciences NAS of Ukraine. Based on the analysis of literature sources on the sintering of TiB_2 – $MoSi_2$ composite powder by various methods, as well as according to the equilibrium state diagram, SPS modes were selected that allow lowering the consolidation temperature to 1500 °C in order to prevent grain growth [1–4].

The SPS process was carried out on "STRUM-902" equipment, which uses a current with an industrial frequency of 50 Hz. The mechanical pressing during SPS was 35–40°MPa in order to maintain sufficient electrical contact between the particles and was kept constant until the end of the process. In order to reach the working temperature level of the SPS in graphite mold, the starting value of the electric current was 800-1000 A, and at the finish of the process it increased to 1.4-1.5 kA at a temperature on the outside of the graphite mold of 1200-1300 °C. Duration of isothermal exposure was up to 15 seconds. The total duration of the SPS process was 90-110°s, which is a relatively short-term consolidation mode for the composition of TiB_2 – 20% (wt.) $MoSi_2$.

The composite material, what is obtained, had a cylindrical shape with a diameter of 20–21°mm and a height of 4–5°mm (Fig. 1). The mass was 4.2–4.6°g. The calculated density of the material was in the range of 3.82–3.89 g/cm^3.

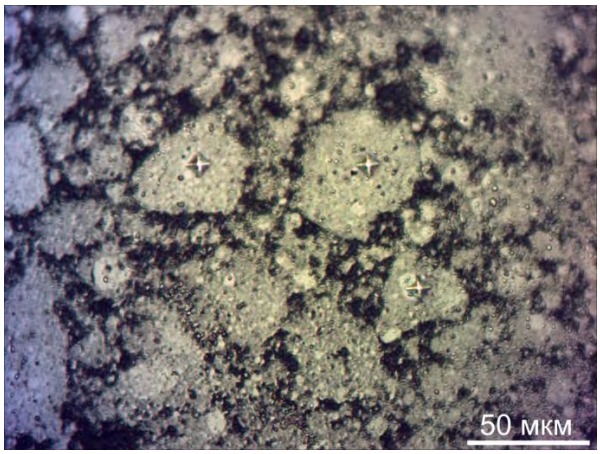

Fig. 1. The sample of ceramic what is obtained by SPS

Fig. 2. Microstructure of TiB_2 – 20% (wt.) $MoSi_2$ obtained by SPS, ×400

The metallographic analysis at ×400 magnification showed the submicron structure of the sample (Fig. 2). The measured microhardness of the obtained material under a load of 100 gf was in the range from 17.9 to 22.3 GPa.

Conclusion – The possibility of rapid consolidation of the composite powder with the composition of TiB_2 – 20% (wt.) $MoSi_2$ by the SPS technology and obtaining dense ceramics with a fine-grained structure and a hardness of up to 23 GPa is demonstrated.

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