Нікітін С.В.
(КПІ ім. Ігоря Сікорського, м. Київ)

STRUCTURE AND PROPERTIES OF DIRECTIONALLY SOLIDIFIED TiB_2-SiC, TaB_2-SiC, NbB_2-SiC AND B_4C-NbB_2 ALLOYS

serg.niki@i.ua

Analysis of current scientific literature revealed several features of the electronic structure and physicochemical properties of high-temperature borides and carbides, which show that the composite materials based on them have high physical and mechanical properties over a wide temperature range, making them promising candidates for use as a wear-resistant and high-temperature structural materials [1].

The microstructures of directionally solidified TiB_2-SiC, TaB_2-SiC, NbB_2-SiC and B_4C-NbB_2 alloys were studied. Metallographic analysis shows that the smallest size of reinforcing particles observed for B_4C-NbB_2 alloy, and the largest for NbB_2-SiC alloy [3]. Research of phase composition by XRD fully confirms data of metallographic analysis and points out that the obtained composites consist of only two phases that correspond to the initial components.

The micromechanical properties of obtained alloys were investigated. It is shown that in general integral microhardness of composites corresponds computed by the rule of mixtures, but some anisotropy was observed, which can be caused by the anisotropy of the microstructure and the presence of residual stresses [2]. It is shown that at load on the indenter of 200 g the cracks in the corners of prints were not clearly observed [4]. Therefore, the definition of fracture toughness in the future should be carried out at high loads.

In this work we pay careful attention to directionally crystallized alloys of systems based on boron carbide and silicon carbide, accordingly TiB_2-SiC, TaB_2-SiC, NbB_2-SiC and B_4C-NbB_2.

The aim of investigation is to study the structure and properties of eutectic alloys based on refractory compounds by the crucibleless method of unsintered powder pressings.

Methods and apparatus which were used to investigate such engineering topic are: obtaining of directionally crystallized alloys of TiB_2-SiC, TaB_2-SiC, NbB_2-SiC and B_4C-NbB_2 was carried out at the "Crystal-206"installation, the microstructure of materials was research on an optical microscope "NEOPHOT-21", research hardness on the appliance PMT-3, X-ray recording was conducted by diffractometer Rigaku Ultima IV.

By crucibleless zone melting method directed crystallized alloys ofTiB_2-SiC, TaB_2-SiC, NbB_2-SiC and B_4C-NbB_2composites were obtained. Microstructures research showed that they are a matrix of boron carbide and silicon carbide reinforced by rod and plate inclusions of titanium, tantalum and niobium diboride. Research of micromechanical properties showed that the obtained hardness of composite achieves 37 GPa (for composite TiB_2-SiC) [5]. Thus, they may be promising wear-resistant materials.

On the basis of this investigation, it is possible to make such promising conclusions as prepared directionally solidified TiB_2-SiC, TaB_2-SiC, NbB_2-SiC and B_4C-NbB_2 alloys are promising for further research and development of these composite materials as advanced wear-resistant materials, and, given the physical and chemical properties of their components, as high-temperature structural materials.

Література:

1. Лобода П.І. Спрямовано закристалізовані бориди. –К.: Праймдрук, 2012. – 395 с.

2. Thevenot F. Boron Carbide [Текст] / A Comprehensive Review / F.Thevenov // Journal of European Ceramicociety. –1990. –Vol.6. – P.205.

3. Mroz C. Titanium Diboride /Mroz C.// American Ceramic Society Bulletin. – 1995. – Vol. 74, No – P. 158…159.

4. Gary Lynn Harris. Properties of silicon carbide [Текст] /Gary Lynn Harris. –United Kingdom: IEE, 1995. –P.19; 170…180. – ISBN 0852968701.

5.Morkoc H. Large-band-gap SiC, III-V nitride, and II-VI ZnSe-based semiconductor device technologies [Текст] /H.Morkoc, S.Strite, G. B.Gao, M. E.Lin, B.Sverdlov, M.Burns// Journal ofAppliedPhysics. –1994. – P. 1363. – DOI:10.1063/1.358463.