Vanadium-group metal nitrides ceramic materials prepared by oxidative constructing

Shokod'ko A.V., Ashmarin A.A., Chernyavskiy A.S., Solntsev K.A.
A. Baikov Institute of Metallurgy and Materials Science, Russian Academy of Sciences,
Leninskii av. 49, 119991 Moscow, Russia
shokodjko@rambler.ru

At present, refractory metal nitrides intended for engineering applications are prepared in the form of consolidated materials by powder metallurgy and casting and in the form of films by various methods as well as. Owing to the unique combination of physical and chemical properties, refractory metal nitrides are applied as protective, decorative and superconducting articles, etc. Taking into account the high melting temperature and high hardness of nitrides applied in manufacturing shaped articles, multistage technological processes are used. To realize the preparation of the materials in the single-stage manufacturing process, the method of oxidative constructing of ceramic materials was suggested.

Earlier, the consistency of oxidative constructing for manufacturing titanium-group ceramic materials was demonstrated. The feature of the method consists in the direct nitriding of a metallic blank heated to a synthesis temperature in an oxidizing gas medium. For the purpose, an experimental setup for manufacturing ceramic materials was designed and assembled. Experimental samples of vanadium and niobium nitrides in the form of ready-made ceramic elements were prepared by the single-stage method. Complex studies (structural, strength, electrophysical) of the experimental samples were carried out. The data obtained were compared with those available for the materials prepared by traditional methods. Thermodynamic parameters of the synthesis were chosen; depending on the synthesis conditions, internal stresses vary substantially, which were calculated using an original X-ray technique. In contrast to the traditional "$\sin^2\psi$" method, this procedure allows one to avoid errors in measuring the lattice parameters, which are related to the concentration nonuniformity of nitrogen interstitial solid solution. In terms of the study performed, the consistency of oxidative constructing of ceramic materials for vanadium-group metals is demonstrated. Optimum parameters of the synthesis were found.

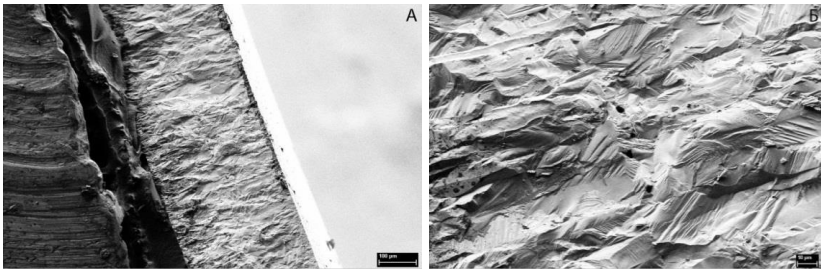

Fig. SEM images (taken with different magnifications) of vanadium nitride. Spallings