POSSIBILITY OF NANODISPERSED SILICON CARBIDE SYNTHESIS BY A FREE SPACE HYPERVELOCITY PLASMA JET[1]

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Silicon carbide (SiC) is only stable compound in the Si-C system. There are many unique physical properties of this material: superhardness, high mechanical strength and Young's modulus, thermal and corrosion resistance, radiation hardness, unique semiconducting characteristics [1, 2]. So silicon carbide can be used for production of externally stable ceramics and SiC-based electronic devices [3]. The use of nanodispersed SiC powders can be used for nanostructured ceramics with higher operational characteristics because materials physical and chemical properties depend on crystallite sizes. Different methods (a combustion synthesis, a physical vapour transport (PVT), a chemical vapour deposition, a sol-gel method, liquid phase sintering, mechanical alloying and a plasmochemical synthesis) is applied for nanodispersed silicon carbide synthesis but these methods do not allow to synthesize an optimal product (with high purity and required dispersity by direct and inexpensive method) [4].

The SiC nanopowder synthesis can be realized in a hypervelocity pulse jet of the dense Si-C plasma. The hypervelocity plasma jet is generated by a pulsed heavy-current coaxial magnetoplasma accelerator (CMPA) with a graphite central electrode and pipe electrode [5]. The possibility of above synthesis method is shown in [6]. The process was carried upon the influence of a Si-C plasma jet to a copper barrier. In the present study plasma jet expires in an argon space of a reactor chamber. The power supply of the CMPA is provided by a storage condenser with a battery capacity of $C = 6$ μF and a charging voltage U=3 kV.

The powder product was obtained using the above method and was investigated by modern analytical techniques such as X-ray diffractometry (a Shimadzu XRD 7000 diffractometer, CuKα radiation) and transmission electron microscopy (a Philips CM 30 electron microscope). The product diffraction pattern is shown in Fig. 1. The XRD-data was analyzed by the Powder Cell 2.4 program and base of structural data PDF 4+. The XRD-pattern character and coherent reflexes set indicate the practical absence of an amorphous component and the presence of several crystalline phases in the synthesis product. Computer calculations showed the product consists of four crystalline phases: cubic silicon carbide β-SiC, space group SPGR (F-43m) {216}; cubic silicon cSi, SPGR (F-43/d-32/m) {227}; graphite gC, SPGR (P6-3mc) {186}; and carbon onion structures C-Onions, SPGR (P6-3mc) {186}. According to calculations the expected phase β-SiC is dominant (~ 80.0%).

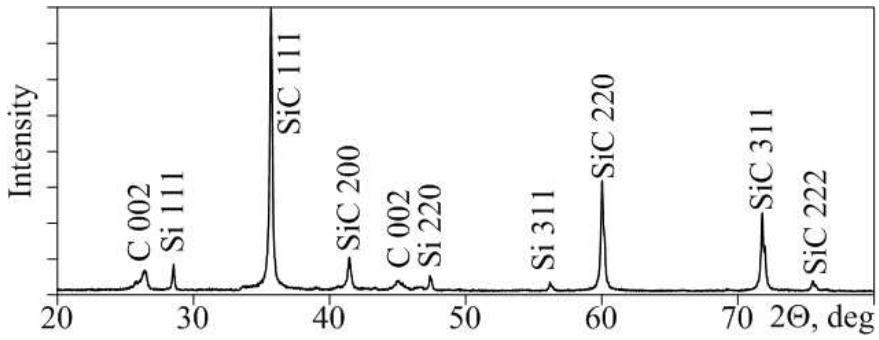

Fig. 1. The product diffraction pattern

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