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P2.207 Properties of boron carbide ceramics made by various methods for use in ITER

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One of the functions of ITER diagnostic port-plugs is neutron protection of the equipment installed in the port, as well as reducing the radiation background in the area of reactor elements requiring access for maintenance personnel. Engineering restrictions on the full weight of the port plug and the amount of water in the reactor do not allow the use traditional iron-water protection. Boron carbide is an alternative protection material. Due to the low atomic weight and high absorption cross-section of thermal neutrons, boron carbide can serve as an effective flux attenuator for both fast and thermal neutrons.

Properties of ceramic based on boron carbide essentially depend on the technology of its manufacture. In this regard, for decision-making on the possible use of a certain type of ceramics in ITER it is necessary to conduct measurements of the elemental composition and physical properties of ceramics thermal conductivity and outgassing rate in a vacuum.

Within the framework of the work, research was carried out on ceramics based on boron carbide manufactured at Russian enterprises. Samples of ceramics were submitted by Virial (St. Petersburg), NEVZ-Ceramics (Novosibirsk), Beeforce (Tver), Izomed (Moscow). Hot-pressed, reaction-bonded and sintered boron carbide ceramics as well as the initial powder were studied.

The elemental composition of the samples and the impurity content were investigated by scanning electron microscope with energy dispersion attachment and by the amount of x-ray radiation attenuation in the samples. In addition, measurements were made of the outgassing rate into the vacuum and mass spectrum allocated to the residual gas and contact conduction thermal transitions ceramic-on-ceramic and ceramic-stainless steel. It was found that in hot-pressed and sintered boron carbide impurities are not more than 1%, in reactive boron carbide the content of impurities can reach 10-15% (mainly silicon or oxygen in different types of ceramics).

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