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THE STUDY OF THERMAL SHOCK EFFECTS ON HIGH-TEMPERATURE CERAMIC MATERIALS PROMISING FOR COATING THE FIRST WALL OF FISION REACTORS *)

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One of the key problems in creating a fusion reactor is the one of the plasma-facing wall. In a magnetic confinement reactor, the first wall of the working chamber and the plasma receivers in the divertor are known to be exposed to thermal shocks that occur because of transients in the reactor plasma. Such thermal shocks are extremely destructive for the first wall. Recently, high-temperature ceramic composites have drawn attention as a material for the first wall, as well as thin-film ceramic coatings with a relatively low average atomic number. Materials with the low atomic number have the advantage that if they enter the plasma as impurities, there should be no significant increase in plasma losses due to radiation.

The experimental facility BETA is used to study the effects of thermal shocks on various materials at the BINP SB RAS [1–2]. The facility has been modified – an ytterbium fiber laser with the ability to modulate the radiation intensity has been installed, which allows modeling a wide range of thermal shocks. At the experimental facility, in situ pyrometry determines the temperature dynamics using single-color or two-color methods. The additional diagnostic determines the dynamics of changes in sample surface light scattering. Thus, all diagnostics make it possible to describe in detail the change in the state of the material surface during its heating.

During the experimental work, a TiB_2AlN sample was tested using the pulse-periodic laser mode. The experimental results allowed describing the maximum temperature reached during heating and the erosion of the sample surface. The temperature dynamics during heating were compared with calculations based on thermophysical data for various materials. In addition, the erosion of the sample surface was studied using a scanning electron microscope (SEM). Thus, information of the TiB2AlN resistance to heating was obtained and a conclusion was drawn that its use in fusion reactors is promising.

References

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