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PLASMA DEVICES FOR TESTING MATERIALS AND IN-VESSEL COMPONENTS OF A THERMONUCLEAR REACTOR *)

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Experience in the use of in-vessel structural materials in modern tokamaks, experimental testing of materials and elements used for plasma-facing components in the ITER tokamak reactor, have revealed a number of significant problems with the resistance of structural materials under the influence of plasma, beam, and thermal loads expected in a thermonuclear reactor. In recent years, experimental tests of in-vessel components based on tungsten (JET, WEST, AUG, T-10 tokamaks and other plasma devices), beryllium (JET tokamak, KSPU-Be facility), molybdenum and lithium (EAST tokamak and PLM plasma device), steels and other materials have been conducted in the world's fusion centers under critically high heat loads of more than ten megawatts and pulsed gigawatt loads (see review [1]), which have shown the erosion and even destruction of materials, significant modification of plasma-facing materials, which can significantly reduce the efficiency of plasma confinement and the efficiency of thermonuclear energy production of the reactor. It is necessary to analyze the experimental results of testing materials used in tokamaks obtained in recent years. In the world's leading fusion centers, testing of candidate materials for a thermonuclear reactor will be performed on plasma steady-state and pulsed devices: in Russia on PLM-M, PR-2, PR-8, PF-3, QSPA and other operating and under-construction devices, in the USA - MPEX and others, in China - CRAFT, in Europe - Magnum-PSI, in Japan - NAGDIS-II and others). The Kurchatov Institute is developing a project to construct a universal multi-task research complex UNIMAT-TS for plasma-beam, thermal and hydrogen tests and research of structural and materials and components, plasma technologies for use in thermonuclear reactors and fusion neutron sources. The experimental results obtained will be used to justify the choice of structural and functional materials required for the construction of a thermonuclear fusion reactor.

Experimental testing of materials with powerful plasma loads on modern plasma devices will also ensure the development of new plasma technologies [2] for the synthesis of new materials with programmed properties for nuclear, chemical, aerospace technologies, for biotechnology and biomedical applications.

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References

[1]. Budaev V.P. Issues of atomic science and technology. Thermonuclear fusion. 2015, 38, 4, 5.
[2]. Budaev V.P. Innovative directions of development of plasma technologies. Proceedings of the XLV International (Zvenigorod) Conference on Plasma Physics and Controlled Fusion, April 2–6, 2018

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