PLASMA and E-BEAM TESTS OF TUNGSTEN DIVERTOR FACING MOCK-UPS

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Thermal loads on tungsten plates of the lining of the divertor in ITER at the stationary discharge stage can reach values of more than 10 MW/m2 (up to 20 MW/m2) and during disruptions and ELMs, pulse loads will increase significantly (see [1]), which can lead to significant overheating and even to tungsten melting. Relevant tests of the divertor mock-up and prototypes are required.   
It is extremely important to ensure adequate conditions for the beam and plasma heat load on   
tungsten [1] and to develop methods for the effective cooling of divertor modules.



Fig. 1. The tungsten divertor mock-up made of ITER materials, tungsten plates of 20 x 20 x   
8 mm are soldered onto a CuCrZr bronze base, a tube for water cooling with a diameter of 14 mm.

For plasma-beam tests in the Efremov Institute (NIIEFA) was designed and manufactured water-cooled mock-ups of the ITER divertor plate, Fig. 1. It was used ITER-grade tungstenVM-P   
(see [1]). Such water-cooled mock-ups are tested at NRU “MPEI” with the combination of plasma and e-beam loads: (1) thermocyclic tests be powerful electron beam with a load from 5 to   
40 MW/m2; in these tests, water cooling is provided; and after (2) testing in the PLM plasma device [2] with stationary plasma loads of 0.5–1 MW/m2 and more. Such two tests are carried out for the first time and simulate the variable load on divertor plates in the ITER in stationary discharges with ELM events. Plasma tests in the PLM device [2], which is a linear system with a multicusp magnetic plasma confinement, are carried out for the first time. The peculiarity of such an device is a stationary hours-long discharge. The plasma parameters in this setup, the electron density is more than 1012 cm-3, the electron temperature is several eV, similar to the parameters of the near-wall plasma in the tokamak, which, combined with the condition of a stationary multi-hour load on the target, creates adequate model conditions for plasma testing of fusion materials. The results of such tests are of interest for evaluating the erosion of tungsten in a fusion reactor, including ITER, fusion neutron source FNS and DEMO.

References

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