In-pile Testing of the ITER First Wall Mock-Ups at Relevant Thermal Loading Conditions

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The paper describes experimental technique and some preliminary results of thermal fatigue testing of the water-cooled ITER PFW mock-ups inside channel of the experimental fission reactor RBT-6 (RIAR, Dimitrovgrad, Russia). This experiment has provided simultaneous effect of neutron fluence and thermal gradient based damages on tested mock-ups to have higher correspondence to real PFC operation conditions in comparison with prevailing tests where neutron and thermal fatigue factors are simulated in series.

The experimental in-pile assembly contained two water-cooled first wall mock-ups with dimensions of 114(L)x56x56 mm\textsuperscript{3}, armored with two beryllium tiles (h=10 mm) each. One of these mock-ups was manufactured by EFDA team with application of the HIP technology and the second one was made in Efremov Institute by method of CuCrZr/SS casting with posterior fast brazing of the armoring tiles. The high-temperature flat ohmic graphite heater, operated by PC-controlled power supply system was used for cyclic thermal loading of the armored mock-ups surfaces. Transfer of heat from heater to the mock-ups was provided by radiant heat exchange (approx. 70\%) and by thermal conductivity of the protective helium atmosphere through a gap of 2.5 mm (approx. 30\%).

The presented experiment has been continued for 200 days of effective irradiation with final damage level in the mock-ups (CuCrZr) of 0.75 dpa. About 3700 thermal cycles with nominal heat flux onto mock-ups of 0.4-0.5 MW/m\textsuperscript{2} were done before the heater failure and then the irradiation was continued in a non-cycling mode.