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P3.116 Continuous laser illumination for in situ investigation of tungsten erosion under transient thermal loads

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Transient heat fluxes up to 1 MJ·m-2 on divertor area are expected during operation of ITER. They can lead to severe erosion of plasma-facing components. Studies on tungsten damaging under thermal shocks are widespread, but they are mainly concentrated on postmortem analysis of the exposed samples. Main feature of the experiments conducting on electron beam based test facility called BETA is application of optical diagnostics for in situ investigation of material erosion during transient heating.

Two optical diagnostic techniques are employed on this facility: recording of thermal radiation of the target and its imaging with illumination by light of continuous laser. Fast CCD cameras and photodiodes followed by ADC are used for recording of spatial and time-resolved temperature distribution on the surface. Tungsten tiles were polished to mirror state for this research. Sample surface is illuminated with continuous laser so that specularly reflected beam passes along axis of lens of the optical system. Major crack network is clearly visible on surface images obtained by CCD camera in this configuration. A fraction of the laser radiation is deflected by beam splitter to a set of optical fibers which records intensity of specularly reflected and scattered by the surface laser beam.

Tungsten tiles were exposed to heat loads below melting threshold with pulse duration up to 300 μs. Two distinct and time-separated processes were observed by continuous recording of intensity of scattered laser radiation. The first one occurs during and shortly after exposure for 50 ms. The second one has very sharp edge (<30 μs) and appears with relatively long delay (up to 1 s) when the target already cooled down to almost room temperature. The latter phenomena can be interpreted as formation of major crack network on the sample surface.

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