BETA facility for *in-situ* observation of surface damage by intense transient heat loads

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Fast transient thermal loads due to incompletely suppressed ELMs remain a serious problem for the ITER divertor [1]. For experimental simulation of the behavior of refractory materials under thermal loads with parameters relevant to the ITER divertor when ELMs occur, the BETA facility based on the electron beam was created at the Budker Institute in Novosibirsk [2,3], the current state of which is described. The main distinguishing feature of the facility is the possibility of a detailed *in-situ* study of the behavior of materials both at the heating stage and during subsequent cooling. Pulsed heating of the samples is carried out using an electron beam, the duration of which is increased to 1 ms. Diagnostic methods for studying the state of the surface are mainly optical and use either thermal radiation from the heated surface of the sample or illumination of the surface by radiation (532 nm) from a cw laser. Moreover, each technique includes both 2D imaging at selected time points, and continuous recording of radiation intensity in selected image areas. Diagnostic equipment consists of fast CCD and SWIR cameras and photodiodes with amplifiers. Using the measurements of thermal radiation, the dynamics of the surface temperature profile of tungsten samples with temperatures above 700 °K is measured, and the regions of overheating caused by defects in the starting material or caused by erosion due to pulsed heating are detected and localized. Laser illumination allows observation of the temporal behavior and spatial distribution of the increase in surface roughness, to track the moment and structure of cracking as well as to follow the surface modification by heat pulses after cracking. Measurement of the spatial pattern of laser radiation reflected from the back surface of the sample allows monitoring the temporal variation in the bending of the sample, which helps to evaluate the thermal stresses that arise in the sample and ultimately lead to cracking of its surface subjected to thermal shocks.