Contribution ID: **387** Type: **Poster**

FTP/P1-10: Simulation Experiments of ELM-like Transient Heat and Particle Loads using a Magnetized Coaxial Plasma Gun

Tuesday, 9 October 2012 08:30 (4 hours)

A magnetized coaxial plasma gun (MCPG) device has been developed for simulation experiments of transient heat and particle loads during type I edge localized modes (ELMs) predicted in ITER. The MCPG has been recently upgraded to increase surface absorbed energy density up to ˜ 2 MJ/mˆ2 that makes it possible to investigate of tungsten (W) melting behaviors. In the experiment, mono-block W samples, to be used for the ITER divertor, were exposed to repetitive pulsed hydrogen plasmas with duration of ˜ 0.2 ms, incident ion energy of ˜ 50 eV, and surface absorbed energy density of ˜ 0.7, 1.4, and 2 MJ/mˆ2. No melting occurred on the mono-block W surface at energy density of ˜ 0.7 MJ/mˆ2, while major cracks were formed. Cracking and melting of the mono-block W surface were clearly observed at energy density of ˜ 1.4 and 2 MJ/mˆ2. Micro-sized cracks were identified for energy density above the melting threshold.
It is considered that the micro-sized cracks were formed due to surface melting and resolidification in each plasma pulse. The mono-block W samples with pulsed plasma irradiation will be exposed to cyclic heat loads of ˜ 20 MW/mˆ2 in an electron beam facility JEBIS at JAEA in order to investigate damage of ITER divertor materials under a combination of steady-state and transient heat loads.
Moreover, we introduce a new experiment using two MCPG devices to understand vapor shielding effects of a W surface under ELM-like pulsed plasma bombardment. The second plasmoid is applied with a variable delay time after the first plasmoid. A vapor cloud layer in front of the W surface produced by the first plasmoid irradiation could shield the second pulsed plasma load on the W surface. In this upgrade, weight loss measurements of W samples after pulsed plasma exposures became possible, which is a grate advantage for quantitative evaluation of vapor shielding effects on erosion of W.

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Session Classification: Poster: P1

Track Classification: FTP - Fusion Technology and Power Plant Design