Development of magnetized coaxial plasma gun for simulation experiment of ELM heat loads on ITER divertor

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Thermal transient events such as type I edge localized modes (ELMs) and disruptions are critical problems for lifetime of plasma facing components (PFCs) in ITER [1]. The heat load on the PFCs during type I ELMs in ITER is estimated to be 0.5-3 MJ/m^2 with a pulse length of 0.1-0.5 ms. Experimental investigations of plasma surface interaction under the conditions simulating transient heat loads in ITER are important for determination of erosion properties of the PFCs. We have started to develop a magnetized coaxial plasma gun (MCPG) [2] at University of Hyogo for simulation experiments of ELM heat loads on ITER divertor. The MCPG has inner and outer electrodes made of stainless steel 304. The diameters of inner and outer electrodes are 0.06 m and 0.14 m, respectively. The discharge gas is deuterium in this study. The power supply for the MCPG is a capacitor bank (7 kV, 1 mF, 25 kJ). A slowly rising radial magnetic field is imposed in the gun region by external bias solenoid coils. The bias solenoid coils produce a poloidal bias flux of ~ 2 mWb. The line-averaged electron density measured by a He-Ne laser interferometer was 1-4x10^{21} m^{-3}. The plasma velocity estimated by time of flight measurements of magnetic fields was about 50 km/s, corresponding to the ion energy of 30eV for deuterium. A calorimeter was applied to evaluate the absorbed energy density of the plasma stream. It was found that the observed energy density of 0.3-0.7 MJ/m^2 and the pulse width of 0.5 ms were similar to those for expected type I ELMs in ITER. It is planned that the inner electrode is covered with tungsten by a vacuum plasma spraying technique to suppress the release of impurities from the inner electrode during the discharge. Further improvement of the MCPG and detailed experiment of the plasma exposure to the candidate materials for the PFCs in ITER will be shown in the conference.

References:

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