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ダイバータシミュレータで発生したカーボンダストの生成と輸送の放電電力の効果
Effects of Discharge Power on Formation and Transport of Carbon Dust Particles Generated in a Divertor Simulator

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In fusion devices, dust particles pose safety issues related to its chemical activity, tritium retention, and radioactive content. They are also known for causing operational issues such as deterioration of plasma confinement [1]. Due to these reasons, the maximum quantity of dust particles in the ITER vessel is limited below 6 kg of carbon. So far we have found that large amount of dust particles in nanometer size are generated both in the Large Helical Device (LHD) and in a helicon discharge reactor [2, 3]. Here we discuss formation and transport mechanisms of dust particles based on results of the power dependence of energy fluxes from plasmas towards a target wall and dust flux towards a substrate for dust collection in the helicon discharge reactor.

Experiments were carried out using the helicon H_2 discharge reactor [2]. The magnetic field of 150 Gauss was applied uniformly along the center axis of the discharge tube with the four magnetic coils. H_2 gas was supplied with a pressure of 5mTorr. H_2 plasmas were generated by applying 13.56 MHz pulsed RF voltage to a helicon antenna using an RF power supply. The discharging period was 0.25 s, and the interval was 1.0 s. Dust particles were produced due to interactions between a graphite target and H_2 plasmas. Dust particles were collected by DC biased Si substrates of 15x10 mm^2 which were set at 110 mm below the graphite target and on the reactor wall. The area density of dust particles was obtained from the number of dust particles and the observation with a scanning electron microscope (SEM) measurements. Energy influxes from plasmas toward the graphite target were measured using with a calorimetric probe [4].

The collected dust particles can be classified into three kinds: spherical particles, agglomerates, and flakes. The discharge power dependence of the dust flux toward the substrate was obtained with the dust collection on the substrate which was biased at +50 V. The dust flux toward the substrate decreases with increasing the discharge power, whereas the energy influx increases with increasing the discharge power. From these results, the energy influx dependence of the dust flux is deduced as shown in Fig. 1. This figure shows that the dust flux toward the dust collecting substrate decreases with increasing the energy influx toward the target. This result shows a possibility that for the higher discharge power, the more number of dust particles tend to redeposit onto the target due to the higher ion drag force. Therefore dust inventory depends strongly on energy influx to graphite divertor plates in fusion devices.

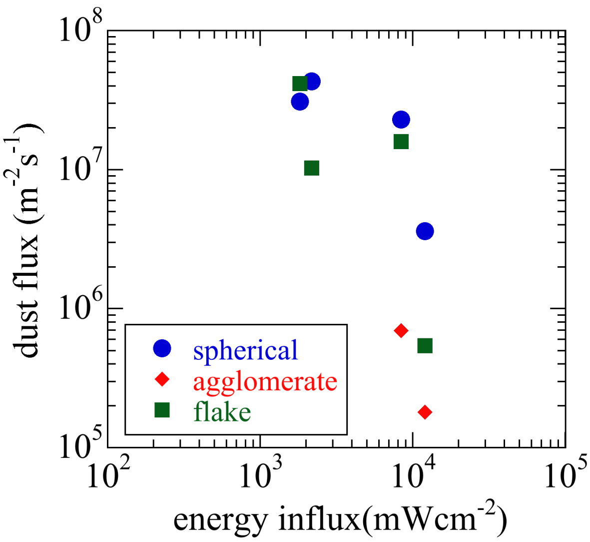

Fig. 1 Energy influx dependence of dust flux

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