§2. Investigation for Hydrogen and Helium Ion Trappings in Graphite Tile of Divertor Plate for LHD

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To reduce the gas inventory of the plasma facing material(PFC)s, it is important for safety, density and impurity controls during the plasma confinement experiment. In order to evaluate the gas inventory in the graphite tile and find a method to reduce the gas inventory due to ion trapping during divertor plasma experiment or glow discharge cleaning, preliminary simulation experiments have been carried out using alternation DC glow discharges with He and H_2 gasses. As the device for simulation test, a test facility ACT[1] with a stainless steel(SUS 304) vacuum vessel of about 400 l in volume was used, which is shown in Fig.1. To monitor the total and partial pressures, a diaphragm gauge and Quadra-pole mass analyzer (QMA) are used at the main vacuum vessel and differential pumping system, respectively. The inner surface area of the vacuum vessel is about $3m^2$. To evaluate the gas inventory correctly as possible, many graphite(IG-430U) tiles were installed inside the vacuum vessel. The total surface area(for inner surface) of the graphite tiles is about 22% of that of the vacuum vessel. The graphite tiles and vacuum vessel are used as the cathode and a square block made of copper and graphite, isolated from ground, is used as an anode electrode for the DC glow discharge.

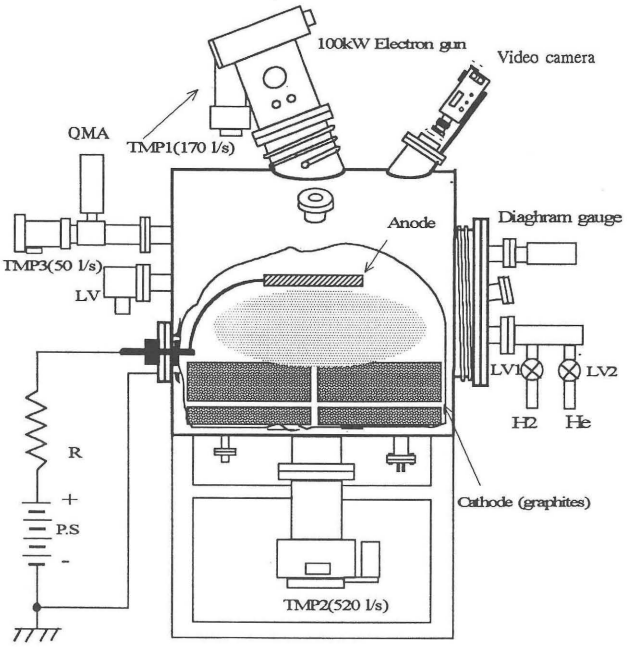

Fig.1 Experimental device(ACT) used to evaluate the ion trapping in graphite tile using a DC glow discharge.

First, a DC glow discharge test with He gas was done for 80 min. under a filling pressure of 18 mTorr and discharge current of 0.3A(0.1A/m^2) to implant He ions into the cathode (graphite and stainless steel). The implanted ion energy is estimated to be 150-200eV. After that, changed to H_2 gas and similar glow discharge was carried out for 80 min. to kick He gas out from the cathode. Between two types of discharges there is a rest of about 20 min. including cooling, vacuum pumping, and gas filling times. Fig.2A) indicates time dependency of hydrogen and He ion currents measured by a QMA during the test. For comparison, the time dependency of the case without graphite tile is shown in Fig.2B).

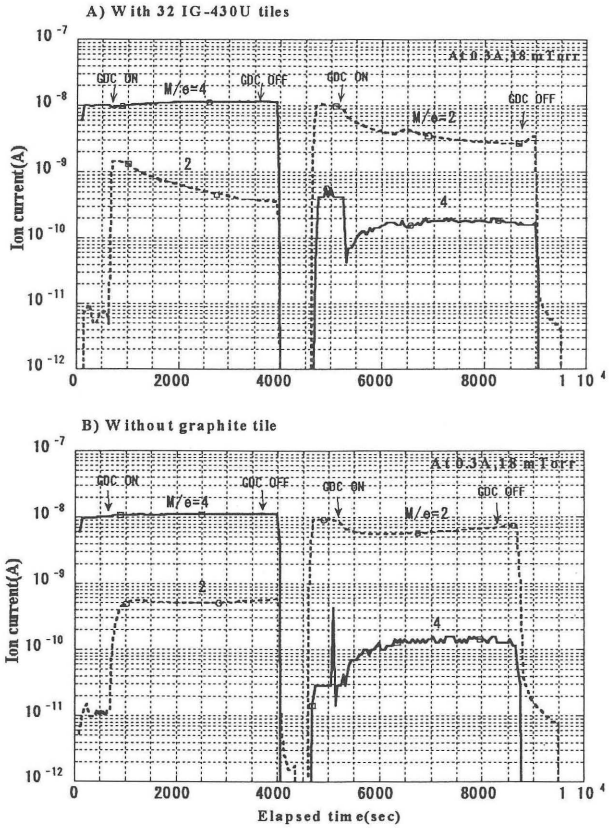

Fig.2 Time dependency of H and He ion currents during glow discharges. A) with graphite tiles, B) without graphite tile.

Preliminary simulation result indicates that there is no large difference for the amount of He ion trapping between graphite and stainless steel, the ratio of which is about 1.5:1. However, there is a large difference for hydrogen ion trapping between graphite and stainless steel, the ratio of which is 7.4:1. To reduce the ion trapping in the graphite tile of divertor plate, an investigation for thin surface coating with molybdenum or tungsten is scheduled on the ACT.

Reference

1) Kubota,Y.,Noda,N., et al.,NIFS-MEMO-13(1994).