Hydrogenic retention studies in DIII-D H-mode discharges*

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Experiments have been preformed on DIII-D to determine the hydrogenic retention rate with an all graphite first-wall tokamak and strong cryopumping. In discharges with $\langle n_e \rangle / n_{GW} \sim 0.3$, a dynamic particle balance shows a majority of the wall retention occurs during the initial ohmic and L-mode phases of the discharge, with wall loading rates typically ~50 Torr-L/s. In constrast during the H-mode phase, the wall uptake is essentially zero to within the experimental measurement error (<5 Torr-L/s), which amounts to ~0.5% of the measured ion flux to the divertor target. In fact, it is observed that the wall particle *inventory* significantly decreases in the H-mode phase, and that the accumulated wall inventory is reduced with the use of divertor cryopumping by ~20%–30% from the highly loaded L-mode phase of the discharge. Particle inventories are measured during the discharge, called “dynamic” particle balance, and compared with high accuracy particle inventories measured after a series of similar discharges, called “static” particle balance. These two methods yield results within 7% and give assurence that both are reliable in determining the amount of particles retained in the graphite tiles. A majority of the experiments are performed in electron cyclotron heating ELMy H-mode discharges to avoid the uncertainy from the neutral beam injection particle source, but similar discharge comparisons with neutral beam injection heating have been done and the results compare well.

Calculations of the dynamic particle balance are also performed on discharges with resonant magnetic perturbation (RMP) edge localized mode suppression. These calculations show that the wall retention rate is dependent on pedestal density and divertor conditions. It is found that the 3D magnetic field structure imposed by the RMP redefines the magetic geometry of divertor, and hence the particle exhaust. Initial results from recent thermo-oxidation experiments to remove hydrogenic isotopes trapped in codeposition layers will also be shown.

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