Methane Penetration in DIII–D ELMing H–mode Plasmas*

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Carbon penetration into the core plasma during midplane and divertor methane puffing has been measured for DIII–D ELMing H–mode plasmas. The plasma facing surfaces on DIII–D, both in the divertor and main chamber, are dominantly graphite tiles, and carbon is the dominant impurity in DIII–D during ELMing H–mode operation. The location of the primary source of the core carbon contamination has not been clearly identified. As a part of the effort to identify the primary sources of the carbon that reach the core plasma, methane puffing measurements have been carried out to supplement extensive spectroscopic measurements of neutral and molecular carbon,

Methane is puffed into standard, diverted ELMing H–mode discharges after a steady operating phase has been reached. The puff duration is sufficient for the core carbon content to reach equilibration. In sequential discharges, methane is puffed from a main chamber valve, and then a divertor valve. Typically, the midplane puff increases the core carbon by about 50%, but global plasma parameters are only weakly affected by the methane puff (line average density, $\langle n_e \rangle$ increases by < 10%, energy confinement time, τ_E, drops by < 10%). The C^{+6} density profiles in the core are measured as a function of time using charge exchange recombination spectroscopy and the total carbon content is calculated using EFIT magnetic equilibrium reconstruction. The methane penetration factor is defined as the difference in the core content with the puff on and puff off, divided by the carbon confinement time and the methane puffing rate. For the case of $\langle n_e \rangle = 0.5\ n_{GW}$ and τ_E = 120 ms, the carbon confinement time is measured as 194 ms, and the penetration factor is 4.5%. Preliminary analysis indicates the penetration factor from a divertor puff is a factor of seven less than the main chamber penetration. Results for ELMing H–mode discharges at higher and lower line averaged density will be presented. Implications for assessing the relative effectiveness of divertor and main chamber chemical sputtering to core contamination will be discussed.

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