DIVIMP modeling of the toroidally-symmetrical injection of $^{13}CH_4$ into the upper SOL of DIII-D*

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A methane-break-up module has been added to the DIVIMP code in order to model the results of the injection of ^{13}C methane into DIII-D. For the cases modeled here, the ^{13}C methane was injected in the outer pumping plenum providing nearly toroidally symmetic injection into the plasma, justifying the standard, but often not satisfied, code assumption of symmetry. From previous ^{13}C puffing experiments on JET, it is believed that a large scale convective pattern in the scrape-off layer (SOL), which transports wall-released C along the main SOL, over the top of the vessel, and down into the inner divertor, led to observation of retention of tritium in the inner divertor of JET. One of the objectives of this experiment was to obtain direct visual confirmation of this convection pattern using toroidally-viewing cameras. A second objective was to establish the efficiency with which wall-released methane is converted to C-ions. The wall is thought to be one of the main contributors to C subsequently appearing in H/D/T co-deposits. The efficiency of conversion to C-ions is likely to be much higher for wall sources than for release from divertor targets where prompt local re-deposition can be strong. A third objective was to measure the efficiency of core contamination of toroidally symmetrical wall sources.

The experiment was carried out over 2 days, with ordinary ^{12}C-methane used on the 1st "plasma characterization" day, and with many repeat shots to maximize edge diagnosis. The rate of injection, 4.4 torr l/s, was established by adjustment to achieve an approximate 50% increase of core carbon density, as measured by charge exchange recombination (CVI), over the no-injection base, which did not significantly disturb the plasma. Injection lasted for 3.0 s in each discharge, beginning after stable L-mode conditions were achieved. The ^{13}C puffing was repeated over a series of 22 consecutive identical discharges on the 2nd day.

Code-data comparisons are made with (a) intensity-calibrated spectral line monitors (CIII, D_α, D_β), a multichord divertor spectrometer (CD, CI, CII, D_α, D_γ) and toroidally-viewing cameras (CII, CIII, D_α), (b) patterns of ^{13}C deposition measured by ion beam analysis from tiles near the injection location. Toroidally-viewing cameras show a strongly asymmetrical CIII "cloud" extending from the injection location, along the SOL into the inner divertor, with no extension toward the outer divertor, confirming the suspected large scale convective pattern. Modeling of the CIII "cloud" will provide quantitative information on the SOL flow pattern.

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