DIRECT MEASUREMENT OF DIVERTOR NEON ENRICHMENT IN DIII–D*

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We report the first direct measurements of divertor impurity enrichment in a diverted tokamak. Enrichment, η, the ratio of divertor to core impurity concentrations, is important because a high concentration of radiating impurities is desired in the divertor plasma to disperse power from the scrape-off plasma before it strikes the target, but only limited concentration of impurities can be tolerated in the core plasma. Previously, a large reduction of core Ar was observed in DIII–D during "puff and pump" (equal D_2 influx and pumping rates), but divertor Ar concentration was not measured.[1] Recently, η for Ne in ASDEX-U was estimated from experimental data using a simple divertor chamber model.[2]

In our experiments, neon and D_2 pressures were measured in the divertor exhaust gas by monitoring visible line intensities in a modified Penning gauge, full radial profiles of core Ne^{+10} density were measured by absolutely calibrated charge exchange recombination (CER) spectroscopy, and the density of less-ionized Ne near the plasma edge was obtained by UV spectroscopy.

Two cases of single-null diverted H–mode plasmas were studied: 1) D_2 puff and pump, at 6×10^{21} D atom/s, and 2) conventional, with neither D_2 puffing nor pumping. Both cases had the same I_p, B_T, n_e ($5.7–6.0 \times 10^{19}$ m^{-3}), ELM frequency (55–60 Hz), and exhaust plenum gas pressure (2.2–2.5 mtorr). Neon was puffed into the private flux from a calibrated valve — a 2 s puff in Case 1, and a single short puff in Case 2. Ne exhaust enrichment was about two times greater for puff and pump than for the unpumped plasma.

Quite unexpectedly, the temporal Ne particle balance indicates a reservoir of ~$1–2 \times 10^{19}$ Ne having a ~10 ms exchange time with the divertor plasma. A model wherein this Ne is stored in near-surface layers of the target, from which it recycles mainly to the divertor plasma, fits the data fairly well.

[1]R. Dux, A. Kallenbach *et al.*, Proc. 22nd Euro. Conf. on Contr. Fusion and Plasma Phys., (European Physical Society, Petit-Lancy, Switzerland, 1995) Part I, p. 69.

[2]M.J. Schaffer, D.G. Whyte, *et al.*, Nucl. Fusion **35**, 1000 (1995).

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