MEASUREMENTS OF DIVERTOR IMPURITY CONCENTRATIONS ON DIII–D


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In this paper, we determine impurity concentrations and radiative losses in the DIII–D divertor region with an absolutely calibrated UV SPRED spectrograph. The spectrograph covers the 100–1100 Å region with a temporal and spectral resolution of 20 ms and 2 Å, respectively. The instrument has a vertical view of the lower divertor along the same line of sight as a bolometer channel and the eight-chord Divertor Thomson Scattering (DTS) system. The vertical and radial extent of impurity radiation zones are determined from a visible tangentially-viewing TV camera with filters. This diagnostic set enables us to calculate impurity densities and radiated power in the divertor region.

Line intensities of D I, C II-IV, N II-V and Ne IV-VIII were measured using the UV SPRED instrument. These measured line brightnesses along with local measurements of the electron temperature ($T_e$) and density ($n_e$) from DTS and excitation rates obtained from the literature are used to calculate the area density ($n_i l$) and the column radiated power (W/cm²) for each impurity ionization state. For strong transitions that lie outside the wavelength region of the spectrograph, the contributions of the unobserved transitions to the radiated power are determined from a collisional-radiative model. These data are then compared to the total radiated power as measured by the bolometers.

Carbon emissions in the divertor during Radiative Divertor Experiments with D₂ puffing have been measured and the radiated power and the temporal behavior of the impurity emissions from spectroscopy are in good agreement with the bolometer measurements. During these experiments, the $T_e$ measured by DTS along the outer leg of the divertor to the outer strike point is nearly constant (~5 eV), and the carbon emissions are also nearly constant, CIV being the leading contributor to the total radiated power. Carbon emissions contribute approximately 90% to the total radiated power with the balance coming from deuterium emissions. Results during Radiative Divertor experiments with detached plasmas induced by injection of neon and nitrogen will also be presented.

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