ABSTRACT

The flow velocities of deuterons and low charge-state carbon ions have been measured simultaneously at the crown of the main SOL in low-density plasmas in DIII-D, and the dependencies of these flow fields on the direction of the cross-field drifts ($\mathbf{E}\times\mathbf{B}$ and $\mathbf{B}\times\nabla$B) have been investigated. The carbon ion flows do not necessarily match those of the deuterons either in direction with respect to the magnetic field lines or in magnitude, suggesting that physics effects apart from entrainment play a significant role in the impurity response. In configurations with the ion $\mathbf{B}\times\nabla$B drift toward the divertor X-point, the deuteron velocities at the plasma crown are high (20–30 km/s in the direction of the high field side divertor), while they are nearly zero in configurations with the opposite $\mathbf{B}\times\nabla$B drift direction. The flow velocities of singly and doubly charged carbon ions are independent of the ion $\mathbf{B}\times\nabla$B drift direction, and the ions flow at approximately 5-10 km/s toward the high field side divertor. Simulations with the UEDGE code have been carried out to better understand the underlying physics processes. Inclusion of cross-field drifts in the simulations produced divertor solutions for density and temperature that agree significantly better with measured divertor parameters. These simulations do not, however, reproduce the measured flow fields at the crown for the configuration with the ion $\mathbf{B}\times\nabla$B drift toward the divertor X-point. The UEDGE code has also been used to understand the influence of pumping at the high field side divertor plate, and a poloidal dependence in the radial transport coefficient.