Impurity Density Calculations from Spectroscopic Measurements of Visible and UV Line Emission on the Alcator C Tokamak

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ABSTRACT

Densities of C, O, and Si during the steady state portion of Alcator C discharges have been computed from spectroscopic measurements of the absolute brightness of visible and UV emission lines in combination with a 1-D transport calculation which models the charge state and emissivity profiles. Profiles of all the charge states of a particular impurity were calculated by utilizing independent measurements of plasma density and temperature and solving the coupled system of transport and rate equations connecting the ionization states. These profiles were then used to calculate emissivity profiles by solving the matrix equation relating the level populations through collisional excitation, collisional de-excitation, spontaneous emission, innershell ionization and cascades from upper levels. Three different types of limiters, molybdenum, graphite and SiC coated graphite, have been used on Alcator C. It was observed that the principal impurities in the plasma, under most conditions, were determined by the type of limiter material being used. However, the source of the impurities could be either the wall or the limiters, since it has been shown that the wall becomes coated with limiter material. A significant influx of impurities directly from the limiters was often seen during the application of lower hybrid RF power to the plasma.