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TH/3-1: Impact of Carbon and Tungsten as Divertor Materials on the Scrape-off Layer Conditions in JET

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In detached divertor conditions, a five-fold stronger reduction of the ion current to the low-field side target plate and a 30% increase in the density limit were observed in neutral-beam heated, low-confinement mode plasmas with the ITER-like Wall compared to the previous carbon wall. These significant differences occurred at higher core densities despite the fact that nearly identical scrape-off layer parameters were measured in attached divertor conditions. When attached, the magnitude and distribution of radiative power as well as the total ion currents to the divertor target plates were measured the same for a range of divertor plasma geometries, including configurations with the high field side strike point on the vertical plate and the low field side strike point on the horizontal plate, and configurations with both strike points on the vertical plates. The 5-to-10-fold reduction of the scrape-off layer carbon content as inferred from low charge state carbon emission, and the fact that both beryllium and tungsten have a low radiation potential in the scrape-off layer, would indicate that the deuterium emission was and still is the dominating radiator. Simulations of deuterium gas fuelling scans with the fluid edge code EDGE2/EIRENE show that replacing carbon with beryllium and tungsten as wall materials leads to reduced impurity radiation, as expected, and translates into an increase in the power conducted to the plates. The ion currents to the plates, however, are predicted to be similar in both materials configurations. Saturation of the ion currents is predicted at the highest achievable density; the simulations do not predict the reduction of the currents close to the density limit as observed in the experiments. Since the JET ITER-like wall constitutes the same materials and their poloidal distribution as foreseen for the nuclear phase of ITER, understanding the observed differences in the SOL conditions between the two materials configuration, and clarifying the discrepancy between the experimental data and simulations are instrumental for erosion and power handling in ITER.

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