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P3.128 Modeling study on divertor plasma by impurity seeding at different locations with SOLPS-ITER

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With the aims of high performance plasma toward ITER and even a fusion reactor, heat exhaust would be a serious problem for HL-2M. In this work, impurity seeding is considered to solve heat exhaust problem by radiative divertor. SOLPS-ITER simulations are performed for Ne and Ar impurities from three seeding locations (lower dome, inner target and outer target) with the standard lower single null configuration.
Simulation results demonstrate the similar high efficiency in reducing heat power of Ne and Ar, and impurity seeding is an efficient method to assure the power load to target plates at an acceptable level even at high heating power (20 MW) during discharges. The efficiency of radiative power exhaust are compared, and Ar can reach higher radiative fraction and it radiates strongly in divertor region as well as inside the separatrix. In addition, modeling shows that total radiation fraction increases with increasing seeding rate of Ne, with most of the radiation coming from divertor region. Simultaneously, the impact of seeding location on divertor plasma is identified, and explained by analyzing impurity distribution and power radiation. Furthermore, the impacts of impurity radiation on the ratio of radiated power to the power into the scrape-off layer and on the effective charge number are analyzed with different seeding rates and locations. Moreover, the divertor plasma is found to have a transition from conduction-limited regime to complete or partial detachment with the increasing of seeding rate. In particular, the peak heat flux and electron temperature on targets are both move away from the strike point with increasing throughput of impurities.
For controlling plasma-surface interactions, the results indicate that Ne is preferential to be used as the radiator. However, the level of Ne seeding rate and seeding location should be modulated to maintain the effective charge number at acceptable values.

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