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Simulation Study of the Impurity Radiation in the Quasi-Snowfalke Divertor with Ne Seeding for CFETR

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It is crucial to exhaust the huge power come from core plasma in future fusion reactor. For a fusion reactor of 1-2 GW fusion power, considering the auxiliary heating power and core radiation, ~200 MW will enter into the scrape-off layer (SOL) and exhausted in the divertor. To find an effective way to exhaust the heat power for future fusion reactor, snowflake divertor (SFD) [D.D. Ryutov, Phys. Plasmas 14 (2007) 064502] is thought as a possible candidate. China Fusion Engineering Test Reactor (CFETR) is proposed to bridge gaps between ITER and DEMO. In our previous SOLPS simulation work [S.F. Mao, et al., J. Nucl. Mater. 463 (2015) 1233], by assuming carbon as the radiation impurity, a reduction in the peak heat flux is shown for the quasi-snowflake (QSF) divertor in CFETR, in comparison with the lower-single-null (LSN) divertor. In order to avoid the fuel retention issue and increase the lifetime of the plasma-facing materials, tungsten wall would be preferred for CFETR, which implies that there will be no intrinsic radiative impurity like carbon. Therefore, radiative impurities, such as neon and/or argon, are indispensable to be seeded. In this work, the radiative SFD with neon seeding are studied by SOLPS simulation. The relation between radiation power, plasma density and effective charge are established for both QSF and LSN divertor. The comparison will give an evaluation of the ability of heat exhaust and compatibility with core plasma for the QSF divertor. Furthermore, the influence of the puffing location on the impurity radiation is also studied, which is considered helpful to find the appropriate impurity seeding scheme.

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