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Experimental research on the deeply detached X-point radiator regime on EAST

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Radiative divertor detachment with impurity seeding is considered one of the most promising means for mitigating particle and heat fluxes on the divertor target. To measure the impurity radiation distribution, a tangentially viewing camera system for lower divertor plasma observation has been developed and installed on EAST. A reconstructed 2D distribution of N II line radiation is obtained based on Phillips-Tikhonov regularization, revealing the electron temperature region in the range of 6-10 eV during a nitrogen (N2) seeding experiment.

With N2 seeding and radiation feedback control, the deep detachment on the lower outer (LO) divertor target with the stable X-point radiator (XPR) has been maintained for ~ 5 s on EAST. The profiles of electron temperature (Tet) and heat flux (qt) with distance to strike point larger than 6 cm (ρ ~ 1.06, larger than λjs) are radially flat on the outer divertor target in the deeply detached state. The peak qt on the LO divertor target in the deeply detached state decreases by more than 80%, compared with the attached state. The strong XPR contributes to the heat flux control on the divertor target and has a good stability. In addition, there are significant decreases of tungsten and boron radiation in the LO divertor region, which indicate an effective reduction of divertor sputtering. In the deeply detached state on the LO divertor target, there is a confinement degradation with decreases of electron temperature, density and pressure in the core region. The above results show that XPR is a promising detachment operation regime for divertor protection in future reactors.

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