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Experimental study on ELMs frequency effect on temperature distribution of divertor on EAST

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The surface temperatures of the upper and lower divertors were measured by an infrared (IR) camera on the experimental advanced superconducting tokamak (EAST). The IR range is 2.5 ~ 5.4μm and the frame rate are from 115 Hz (640×512 pixels) to 2.9 kHz (132×3 pixels). The spatial resolution of the camera is 4 mm on the divertor plate. EAST has equipped the low hybrid current drive (LHCD) at 2.45 GHz and 4.6 GHz, the electron cyclotron resonant heating (ECRH) at 140 GHz, the ion cyclotron resonant heating (ICRH) at 33 MHz, and two neutral-beam injectors with total power up to 8MW. Studies on the divertor heat flux distribution under different auxiliary heating modes have been done on EAST. A second peak heat flux (SPHF) zone, where the heat flux was even stronger than that at the origin strike zone (OSZ), was found on the lower outer (LO) divertor plates with LHCD. And it disappeared immediately after switching of the LHCD. The peak heat fluxes on the LO target plates in the LHCD + NBI H-mode cases are larger than that in the LHCD H-mode with the similar auxiliary heating power. This was because the heat flux profiles of lower outer target plates as a function of plate location in edge localized modes (ELMs) with the LHCD + NBI are narrower than that with the LHCD only. However, further study gave an opposite result in different condition, which indicated that the temperature and heat flux distribution on the divertor were related to the frequency of ELMs.

In the upper single null (USN) configuration discharges with LHCD, ICRH and ECRH, the poloidal temperature distribution on the upper outer (UO) target plate was very wide when the frequency of ELMs was about 50 Hz. The full width at half maximum (FWHM) of the temperature curves were several times larger than that in the discharges with LHCD and neutral beam injection (NBI). However, when the frequency of ELMs was about 150 Hz, the FWHM of the temperature curve in the discharges with radio frequency (RF) waves were less than that in the discharges with LHCD and NBI. It illustrated that the poloidal distribution of the temperature on the divertor target plate was related to the frequency of ELMs. In the double null (DN) configuration discharges with LHCD, the asymmetry of the upper and lower divertor temperature distribution was observed, which also indicated the asymmetry of scrape-off layer (SOL). This asymmetry may be caused by LHCD, which was also related to the frequency of ELMs.

References

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