Modeling of heat flux on the main limiter in EAST

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Heat flux on plasma-facing components is one of the key issues in tokamak operation. In EAST, severe damages on the main limiters due to high heat loads limit high-power and long-pulse operation in recent campaigns [1]. To quantify the heat flux on the limiter surface, a method for inverse calculation of parallel heat flux based on the measured surface temperature has been successfully developed. The PFCFlux and ANSYS codes are used to simulate the distribution of heat power and surface temperature with reasonable assumptions on heat flux decay widths [2]. The inverse calculation results can be well matched with the probe measurements during 1056-s long-pulse discharge. And the relationship between the parallel heat flux decay widths in the regions with different connection lengths is consistent with the prediction of the simple SOL theory. But the heat flux deposited on the main limiter is often affect by fast electrons and fast ions, which causes the inverse calculation results significantly higher than the probe measurements. The heat flux of fast electrons generated by LHW (1.9 MW) is comparable to the heat flux due to background plasma. The heat flux of fast ions generated by ICRF (1.8 MW) or NBI (2.2 MW) can be 8.5 times higher than that of the background plasma. When the ratio of hydrogen to deuterium in the plasma is about 5%, the heat flux of fast deuterium ions generated by NBI-ICRF synergy (ICRF power of 1.5 MW, NBI power of 1.1 MW) is in the same order of magnitude as the heat flux due to background plasma. The heat flux from fast ions is the main reason for the damage on the main limiter during steady state operation and need to be reduced for long pulse and high-power operation in EAST.

Key words: Main limiter, Heat flux, Fast electrons, Fast ions

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[2] C. Y. He, D. H. Zhu, B. G. Wang, et al. Nucl Mater Energy 41, 101763 (2024)