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Edge and Core Impurity Behavior and Transport in EAST H-Mode Plasma with Internal Transport Barrier

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After installation of tungsten divertor in EAST, impurity accumulation of high-Z ions has been often observed in H-mode discharges with ITB [1], due to an enhancement of the impurity confinement inside the ITB. A strong plasma cooling induced by the high-Z impurity caused the collapse of the ITB formation. In recent impurity screening study in RMP-applied discharges temporal behaviors of impurity ions in several charge states such as C^{2+}-C^{5+}, O^{5+}-O^{8+}, Fe^{7+}-Fe^{23+}, Cu^{10+}-Cu^{26+}, Mo^{12+}-Mo^{31+} and W^{24+}-W^{45+} were used for the data analysis [2, 3], from which the line emissions were accurately identified [4]. To study the impurity transport in the NBI-dominant H-mode discharge with ITB, then, temporal behaviors of those line emissions have been also measured with those radial profiles and similar technique is employed for the analysis. As shown in Fig. 1, line emissions from moderately ionized ions like Fe^{17+}, Cu^{20+}, and Mo^{26+} locating outside the ITB ($\rho \geq 0.5$) maintain the intensity at low level during the ITB. In contrast, line emissions from highly ionized ions like Fe^{22+}, Cu^{25+} and Mo^{31+} locating inside the ITB ($\rho < 0.5$) increase the intensity, while the intensity seems to decrease in the second half of the ITB. It is noticed that the constant intensity from tungsten ions of W^{24+}-W^{45+} analyzed from unresolved transition array (UTA) includes line emissions from both inside and outside the ITB. In addition, a large difference is found in the radial intensity profile inside the ITB between experimental results and coronal equilibrium calculation. It suggests enhancement of the impurity confinement time. High-Z impurity transport is therefore studied using the simulation workflow of TGYRO and STRAHL codes. Effects of temperature and density gradients on the impurity transport are also systematically studied.

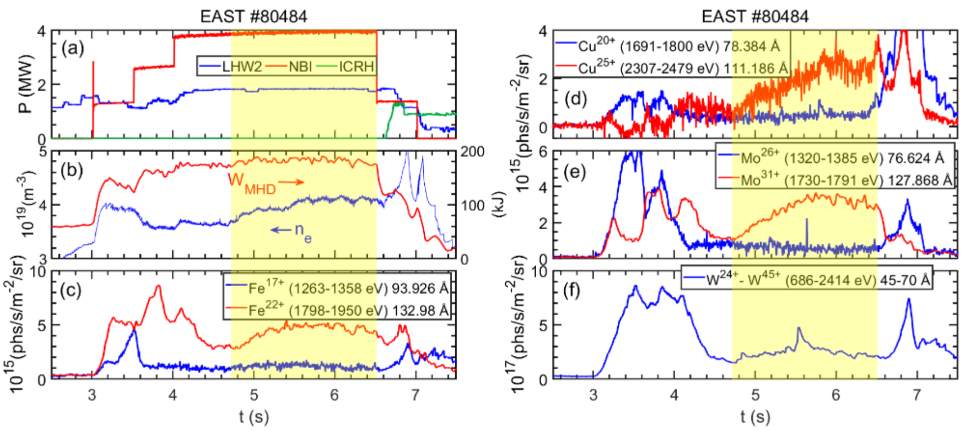

Fig. 1 Waveforms of NBI-dominant H-mode discharge with ITB in EAST; (a) injected power of LHW, NBI and ICRH, (b) n_e and W_{MHD} and line emissions from (c) Fe^{17+} and Fe^{22+}, (d) Cu^{20+} and Cu^{25+}, (e) Mo^{26+} and Mo^{31+} and (f) W^{24+} - W^{45+}. Duration of ITB formation is indicated by yellow shadow.

References
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