§1. Transport Code Development for ITB Formation and Impurity Control

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In fusion reactors, high-Z materials will be used to protect machine against high heat load on divertor plates as plasma facing component (PFC) materials. However, high-Z impurities from these PFCs cause large radiation loss even if the amount of impurities is quite small. This gives rise to the degradation of burning plasma performances. High-Z impurity transport analysis including sawtooth effects is carried out using the toroidal transport analysis linkage (TOTAL) code[1-6]. The Bohm-type anomalous transport model for the core plasma and the anomalous inward flow model for impurity ions are used in addition to neoclassical transport.

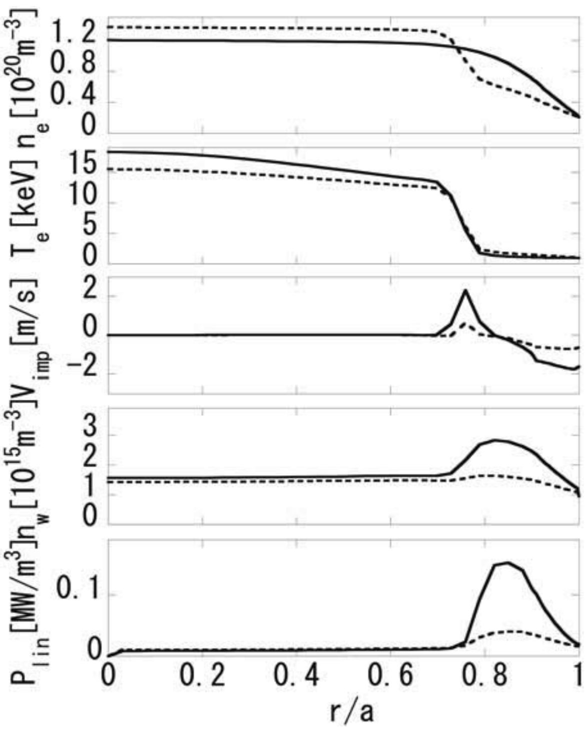

Fig.1 Effects of edge density profile on impurity transport in ITER ITB plasma. Solid line corresponds to the density profile with no ITB gradient, and dashed line corresponds to the ITB density profile.

After comparisons with Joint European Torus (JET) impurity transport data, sawtooth effects on impurity transport in ITER are clarified with a simplified full magnetic reconnection model. The critical levels of impurity concentration in ITER are found to be 4.0% for carbon, 0.1% for iron, and 0.008% for tungsten with respect to electron density. Forming an internal transport barrier (ITB) for electron density can prevent high-Z impurity accumulation (Fig.1). Also, sawtooth oscillation is shown to be beneficial, reducing radiation loss from the plasma core by about 20%, although it might lead to unfavorable fusion power fluctuation of 10% (Fig.2).

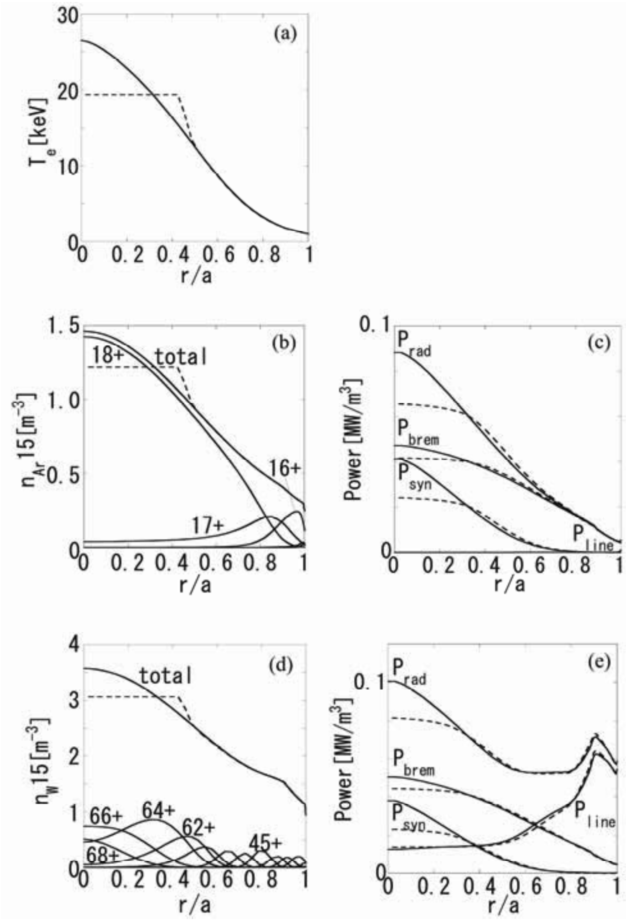

Fig. 2 Simulated sawtooth oscillation effects on impurity ions in ITER plasma. Figure (a) shows the radial profile of electron temperature. Figures (b) and (c) show the total impurity density profile and total radiation profile *P*rad, respectively, in the case of argon, before (solid line) and after (dashed line) sawtooth crash. Radial profiles of line radiation *P*line, bremsstrahlung radiation *P*brem, and synchrotron radiation *P*syn are also shown in Figure (c). Figures (d) and (e) show the corresponding results for tungsten impurities.

1) I. Yamada, K. Yamazaki, H. Arimoto, T. Oishi, T. Shoji, Plasma and Fusion Research **5** (2010) S1022.
2) I. Yamada, K. Yamazaki, H. Arimoto, T. Oishi, T. Shoji, Plasma and Fusion Research **5** (2010) S2033.
3) T. Oishi, K. Yamazaki, H. Arimoto, T. Shoji, Plasma and Fusion Research 5 (2010) S2027.
4) K. Umeda, K. Yamazaki, T. Oishi, H. Arimoto, T. Shoji, Plasma and Fusion Research **5** (2010) S2030.
5) Y. Hori, K. Yamazaki, T. Oishi, H. Arimoto, T. Shoji, Plasma and Fusion Research **5** (2010) S2034.
6) S. Taniguchi, K. Yamazaki, T. Oishi, H. Arimoto, T. Shoji, Plasma and Fusion Research **5** (2010) S2035.