05aE43P

ダイバータープラズマの特徴的温度領域における タングステン不純物輸送の系統的評価

Systematic Study of Tungsten Impurity Transport in Representative Regimes of Divertor Plasma

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1. Introduction

Due to high melting point and high thermal conductivity, tungsten has been considered as candidate for divertor plates and first wall material for the ITER and Demo reactors. However, the atomic number of tungsten is so high that radiational cooling of main plasma may be non-negligible even if a small amount of tungsten penetrates the main plasma.

2. The relation between background plasma profile and impurity transport

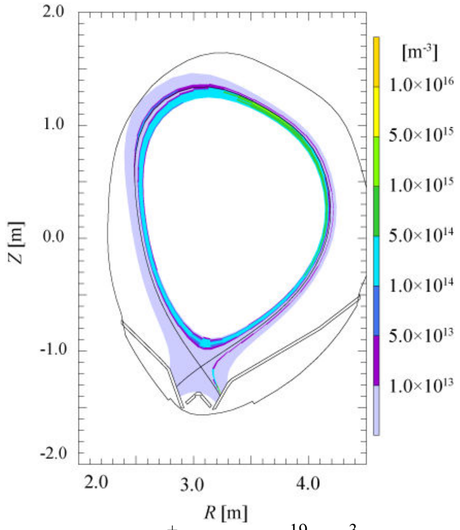
Impurity transport process in the SOL is related to the friction force, the thermal force, and the first ionization point, etc. These depend on the background plasma profile such as the ion temperature, the electron temperature, the ion density, and the ion flow velocity. This means that the background plasma profile makes a difference in tungsten impurity transport process. Systematic studies of the dependence of tungsten impurity transport on the background plasma conditions are needed. As a first step, the dependence of the impurity transport on the upstream plasma density has been studied in the present study.

3. Calculation setups

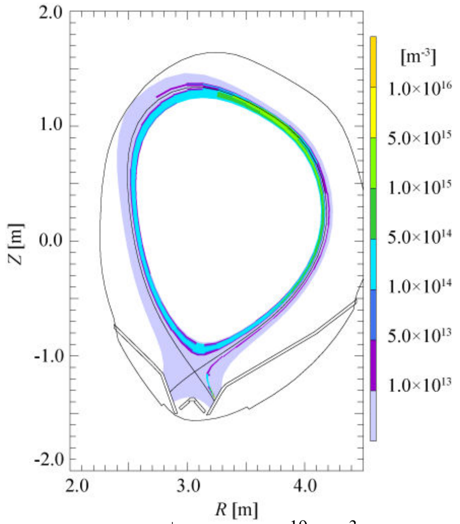
The tungsten impurity transport has been studied by IMPGYRO[1] code for a model tokamak geometry of JT-60U tungsten experiments. The background plasma profiles calculated from SOLPS[2] code has been used. The density profiles of tungsten are compared between the low background deuterium density (Case A: $n_D^+ = 2.0\times10^{19}$ m^{-3} at core side boundary) and the high background deuterium density (Case B: $n_D^+ = 3.0\times10^{19}$ m^{-3} at core side boundary). In the outer divertor region, the plasma is in an attached state for Case A, while it is in a high-recycling state for Case B.

4. Results

Figure 1 (a) and (b) are the simulated 2D profiles of the impurity density including all charge states, respectively for Case A and Case B. In Case A, test impurity ions reach inboard side, while they cannot reach there in Case B. These characteristic features of the density profiles are possibly explained by the balance of the thermal force and the friction force. More details will be presented in the poster session.



(a) Case A: $n_D^+ = 2.0\times10^{19}$ m^{-3} at core side boundary



(b) Case B: $n_D^+ = 3.0\times10^{19}$ m^{-3} at core side boundary

Fig. 1 2D profiles of tungsten impurity density

[1] A. Fukano, *et al.*, J. Nucl. Mater. 363-365, (2007) 211.

[2] R. Schneider, *et al.*, Contrib. Plasma Phys. 3-191, (2006) 46.