23P144-B

Effect of V-shaped target plate on the neutral particle behavior
中性粒子挙動に及ぼすＶ字ターゲット形状の効果

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Experiment on effect of V-shaped target plate on the plasma detachment is done with divertor simulator TPD–SheetIV. The neutral behavior under this experiments is studied with DEGAS 2 simulation code. In this work, new mesh models constructed to simulate more realistic experimental situation and comparison of various simulation results makes the basic behavior of neutrals more clear.

1. Introduction

In fusion reactors such as the International Tokamak Experimental Reactor (ITER), tremendous heat flux (> 10 [MW/m^2]) is expected to flow onto divertor target plates. The development of for reducing the heat flux on the divertor plate is an important challenge for the future fusion reactor design. One of the most promising methods is to establish a so-called detached plasma, whose electron temperature is kept below 1 [eV] by powerful cooling due to gas puffing. The most recent proposal is to use a so-called V–shaped target plate, which is expected to increase the local neutral density and enhance the volume recombination process.

Experimental study of a V–shaped target in the linear divertor plasma simulator, Test Plasma produced by Directed current device for sheet plasma (TPD–SheetIV), has been conducted[1].The V–shaped target enhances recycling, and plasma detachment is effectively achieved in that device. Under such conditions, neutral particles are expected to experience not only transport but also atomic/ molecular processes such as dissociation and ionization. Their behavior has been experimentally studied mainly with H-alpha monitors. However, because of a limited number of ports and channels in the experimental devices, an iterative simulation to determine such parameters is indispensable. Although first simulation results for TPD–SheetIV with DEGAS 2 code [2] are reported in [3], the mesh model is improved and the effect of target geometry is studied farther in this work.

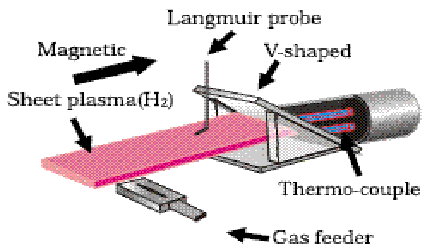

Fig.1: Schematic drawing of V-shaped target plate of TPDSheet–IV.

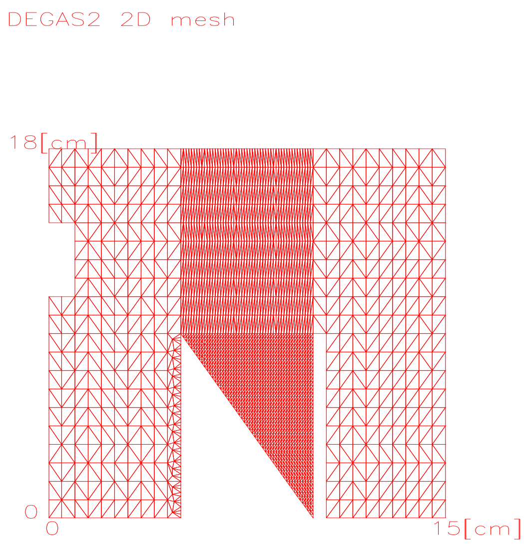

Fig.2: Simulation mesh model for V-shaped target, which was improved from those used for Fig.3 in [3].

2. DEGAS 2 simulation model

Figure 1 shows the sheet plasma and target plate of the TPD–SheetIV experiment. A steady state plasma is produced by a TPD–type dc discharge, and forms a sheet shape with the thickness of only $3 \sim 10$ [mm]. Gas feeder provides additional neutral gas and plasma detachment is induced with it.

Simulation model used in [3] had some difference with the real TPD–SheetIV. That is 1) the direction of inclined plate, 2) relative position of gas feeder, 3) artificial minor modification of recycling source. The third difference was due to minor bug of the code, and is fixed in the latest version source [4]. Figure 2 shows the improved version of V-shaped target model used in [3]. The plasma parameters used in this work are those for the attached condition, since the effect of the target shape on heat load is found to be maximum for small additional gas feed.

3. Simulation result

Firstly the effect of direction of inclined plate is studied. The neutral gas pressure simulated with old mesh model used in [3] is shown in Fig. 3. In this model, target plate faces directly the gas feeder. Hence gas pressure near the plate is relatively high. On the contrary, for new mesh model (Fig. 4), neutral particles from gas feeder is blocked to reach the plate surface by the support structure. The particle number feeded through the gas feeder in these simulation is set to be equal th those plasma ion recycling. So recycling neutral effect seems also to be clear. But we assumed that these neutral is reflected only as high energy Hydrogen atoms and lost from the recycling area soon.

Other effect of target geometry will be presented at the conference site.

Acknowledgements

One of the authors (H.M.) acknowledges Dr. D. Stotler (PPPL), H. Takenaga (JAEA) and B.J. Xiao (ASIPP) for the their advice on DEGAS 2 simulation. This work is performed in part under the auspices of the NIFS Collaborative Research Program (NIFS08KOAP021 /NIFS10KNXN191).

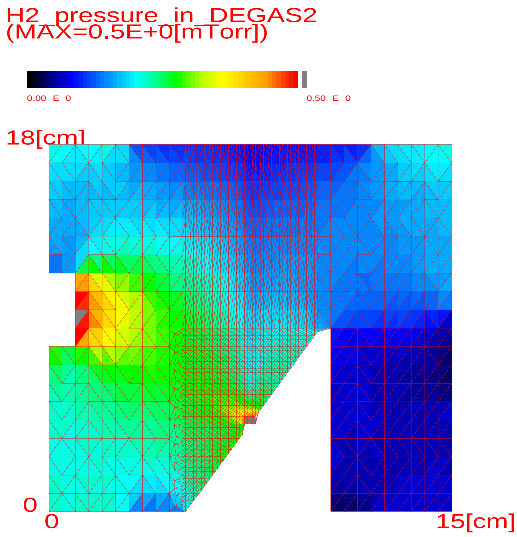

Fig.3: Hydrogen molecular pressure result with the old inclined target mesh model.

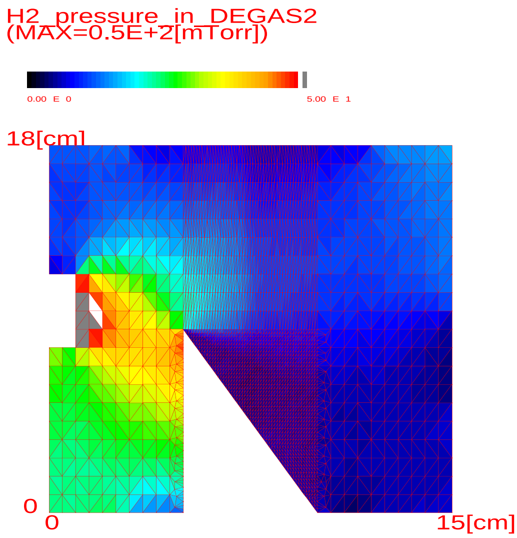

Fig.4: Hydrogen molecular pressure result with the old inclined target mesh model.

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