Contribution ID: **732** Type: **Oral**

Development of a Lithium Vapor Box Divertor for Controlled Plasma Detachment

Thursday 25 October 2018 18:20 (20 minutes)

A lithium vapor-box configuration [1] has been proposed to provide volumetric radiative dissipation in the divertor region of tokamak plasmas. While recent experiments have achieved continuous vapor shielding in close proximity to a lithium coated target in Magnum-PSI [2], this approach seeks to provide controlled detachment far from the divertor target, in a lithium vapor cloud maintained through controlled evaporation and kept away from the main plasma through baffling and recondensation.

We performed edge-plasma simulations with the geometry and parameters of the recent FNSF study [3]. A set of calculations are performed with the 2D UEDGE plasma model and a simple diffusive neutral model [4]. To mimic a crude vapor-box, Li vapor is injected near the divertor plate from the private-flux and outer divertor leg regions and is removed assuming a wall albedo of 0.5 on both PF and outer walls, which allows steady state solutions. For a range of Li vapor input, steady-state, detached-plasma solutions are shown where well over 90% of the exhaust power is radiated by Li, resulting in peak surface heat fluxes ≤ 2 MW/m^2 on the divertor plate, outer wall, and?private-flux wall. While Li ions?dominate in the divertor leg, their density is much less?than the DT density at the midplane. Here the key?issue is possible dilution of the core DT fuel.

We also developed a simulation of the neutral lithium vapor flow in the divertor using the Stochastic PArallel Rarefied-gas Time- accurate Analyzer (SPARTA) Direct Simulation Monte Carlo (DSMC) code [5]. We have simulated the open geometry of the present FNSF design, as well as begun studies using (so far) a single baffle. While the original open geometry allows 75% of the lithium absorption in the plasma to occur in the far SOL, distant from the divertor leg, this is reduced to 5% through the use of a single baffle.

[1] R.J. Goldston, G.W. Hammett, M.A. Jaworski, J. Schwartz, Nucl. Mat. Eng. 12 (2017) 1118
[2] P. Rindt, ISLA Conference, Moscow 2017
[3] C.E. Kessel, J.P. Blanchard, A. Davis et al., Fusion Eng. Design (2017),
http://dx.doi.org/10.1016/j.fusengdes.2017.05.081.?
[4] T.D. Rognlien, M.E. Rensink, and D.P. Stotler, Fusion Eng. Design (2017),
http://dx.doi.org/10.1016/j.fusengdes.2017.07.024
[5] M.A Gallis et al., AIP Conference Proceedings 1628, 27 (2014); doi: 10.1063/1.4902571

Country or International Organization

United States of America

Paper Number

FIP/3-6

Author: GOLDSTON, Robert (Princeton Plasma Physics Laboratory)

Co-authors: STOTLER, Daren (Princeton Plasma Physics Laboratory); Mr EMDEE, Eric (Princeton Plasma Physics Laboratory); Mr SCHWARTZ, Jacob (Princeton Plasma Physics Laboratory); Dr JAWORSKI, Michael (Princeton Plasma Physics Laboratory); Dr MARVIN, Rensink (Lawrence Livermore National Laboratory); Dr ROGNLIEN, Thomas (Lawrence Livermore National Laboratory)

Presenter: GOLDSTON, Robert (Princeton Plasma Physics Laboratory)

Session Classification: FIP/3 DEMO & Advanced Technology

Track Classification: FIP - Fusion Engineering, Integration and Power Plant Design