Abstract Submitted
for the DPP12 Meeting of
The American Physical Society

Simulation of the Partially Ionized Negative Hydrogen Plasma[1]
SERGEY AVERKIN, NIKOLAOS GATSONIS, Worcester Polytechnic Institute, LYNN OLSON, Busek Co. Inc. — A High Pressure Discharge Negative Ion Source (HPDNIS) operating on hydrogen is been under investigation. The Negative Ion Production (NIP) section of the HPDNIS attaches to the 10-100 Torr RF-discharge chamber with a micronozzle and ends with a grid that extracts the negative ion beam. The partially ionized and reacting plasma flow in the NIP section is simulated using an unstructured three-dimensional Direct Simulation Monte Carlo (U3DSMC) code. The NIP section contains a low-pressure plasma that includes H_2, vibrationally-rotationally excited H_2^*, negative hydrogen atoms H^-, and electrons. Primary reactions in the NIP section are dissociate attachment, $H_2^*+e \rightarrow H^0+H^-$and electron collisional detachment, $e + H^- \rightarrow H + 2e$. The U3DSMC computational domain includes the entrance to the NIP nozzle and the extraction grid at the exit. The flow parameters at the entrance are based on conditions in the RF-discharge chamber and are implemented in U3DSMC using a Kinetic-Moment subsonic boundary conditions method. Neutral–neutral, ion-neutral, Coulomb collisions and charge-neutralizing collisions are implemented in U3DSMC using the no time counter method, electron-molecule collisions are treated by the constant timestep method. Simulations cover the regime of operation of the HPDNIS and examine the flow characteristics inside the NIP section.

[1]Supported by the Department of Energy.

Sergey Averkin
Worcester Polytechnic Institute

Date submitted: 10 Sep 2012 Electronic form version 1.4