Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Rotational relaxation process for Argon-Nitrogen mixed gaseous thermal plasma using DSMC simulations. SAHADEV PRADHAN, A. K. KALBURGI, Chemical Technology Division, Bhabha Atomic Research Centre, Mumbai-400085, India. — In this study we investigate the rotational relaxation process for Argon-Nitrogen mixed gaseous thermal plasma with initial state composition 75 mol% of Argon and 25 mole% of Nitrogen, having two rotational degrees of freedom for Nitrogen molecules and with no internal degrees of freedom for Argon and electron using Direct Simulation Monte Carlo (DSMC) simulations. The Larsen-Borgnakke model is applied on a single molecular basis in which the relaxation collision number is approximated by the reciprocal of the fraction of inelastic collisions. The DSMC simulations are carried out for rotational relaxation collision number $Z_r = 7.5$ associated with the Nitrogen molecule and $Z_r = 1$ for Argon and electron with viscosity temperature index ? = *0.75* (VHS model), ? = *1.0* (Maxwell model), and ? = *0.5* (HS model), having different collision rates. The DSMC simulations are compared with the theoretical predictions for translational and rotational temperatures, defined by $T_{tr} = T_{eq} + (T_{tr,0} - -T_{eq})\ exp(-\ \nu t/Z_r)$, and $T_{rot} = T_{eq} - -(T_{eq} - T_{rot,0})\ exp(-\ \nu t/Z_r)$respectively as well as for the molecular velocity distribution and rotational energy distribution, and found excellent agreement (error within 5%), and the collision process do not lead to any distortion of the Maxwellian velocity distribution and the Boltzmann distribution for the energy. -/a

Sahadev Pradhan
Chemical Technology Division, Bhabha Atomic Research Centre, Mumbai-400085, India.

Date submitted: 14 Aug 2020 Electronic form version 1.4