Abstract Submitted
for the DPP16 Meeting of
The American Physical Society

Modeling nitrogen plasmas produced by intense electron beams[1]

JUSTIN ANGUS, STEVE SWANEKAMP, ANDREW RICHARDSON, JOSEPH SCHUMER, DAVID MOSHER[2], PAUL OTTINGER[3], Naval Research Laboratory

— The Gamble II generator at the Naval Research Laboratory produces ∼100ns pulse duration, relativistic-electron beams with peak energies on the order of 1MV and peak currents of about 800kA with annular beam areas between 40-80cm^2. This gives peak current densities ∼10 kA/cm^2. For many different applications, a nitrogen gas in the 1Torr range is used as a charge- and current-neutralizing background to achieve beam transport. For these parameter regimes, the gas transitions from a weakly-ionized molecular state to a strongly-ionized atomic state on the time scale of the beam pulse. A detailed gas-chemistry model is presented for a dynamical description of the nitrogen plasmas produced in such experiments. The model is coupled to a 0D circuit model representative of annular beams, and results for 1Torr nitrogen are in good agreement with experimental measurements of the line-integrated electron density and the net current. It is found that the species are mostly in the ground and metastable states during the atomic phase, but that ionization proceeds predominantly through thermal ionization of the higher-lying optically-allowed states with excitation energies close to the ionization limit.

[1]Work is supported by AWE through NNSA
[2]Independent contractor for NRL through Engility Inc., Alexandria, VA 22314 USA
[3]Independent contractor for NRL through Engility Inc., Alexandria, VA 22314 USA

Justin Angus
Naval Research Laboratory

Date submitted: 07 Jul 2016 Electronic form version 1.4