Abstract Submitted
for the GEC18 Meeting of
The American Physical Society

Plasmas Sustained by High Repetition Rate Nanosecond Pulses: Recombination Mechanisms in Ar with H2O Impurities[1] VLADLEN PODOLSKY, SERGEY MACHERET, Purdue University — Previously, microwave diagnostics was performed for a quasi-steady plasma generated with repetitive nanosecond pulses at several Torr in argon with H2O impurity. In this work, a 0-D kinetic model was developed to understand the recombination between the pulses. The model included electron energy and continuity equations. In pure argon, both the electron temperature relaxation and recombination are very slow. The presence of trace amounts ($< 0.1\%$by volume) of H2O drastically changes the mechanisms and rates of recombination and thermalization. Ar+ ions are rapidly converted to H3O+, and the electron losses are primarily due to dissociative recombination with H3O+. The electron thermalization time is drastically reduced due to excitation of rotational and vibrational levels of water molecules. The model agrees well with the experimental data. The results show that generating plasma with high electron density and low time-averaged electron temperature is possible by combining repetitive pulses and controlled addition of molecular species to noble gases.

[1]Supported by the National Science Foundation under Grant No. ECCS-1619547.

Vladlen Podolsky
Purdue University

Date submitted: 20 Sep 2018 Electronic form version 1.4