Abstract Submitted
for the GEC11 Meeting of
The American Physical Society

Investigation of metastable production in a closed-cell dielectric capillary variable pressure He plasma jet with Ar admixture BRIAN SANDS, UES, Inc., BISWA GANGULY, Air Force Research Laboratory — For plasma processing applications of streamer-like atmospheric pressure plasma jets generated in a dielectric capillary, we have demonstrated that an admixture of Ar to the He gas flow greatly increases the lifetime of energetic species in the core flow through enhanced afterglow production of Ar $1s_5$ metastable species. To study this effect in more detail, we have used a closed-cell plasma jet that allows control over the background gas pressure and composition. We used a 20 ns risetime positive unipolar voltage pulse for excitation. A He flow with a 0-30% Ar admixture was studied using time-resolved emission and tunable diode laser absorption spectroscopy of the Ar $1s_5$ and He 2^3S metastable states. Nitrogen was used as the background gas. In pure He and pure Ar gases the He and Ar metastables respectively are produced in the first $\sim$100 ns only in the active discharge. With Ar added to the He gas flow, He metastables produced in the active discharge are quickly quenched via Penning ionization of Ar while Ar $1s_5$ is enhanced over 1-2 μs in the afterglow, increasing the number density as high as 10^{13}/cc and extending the effective lifetime up to 10 μs. This implies that He heavy particle kinetics are a key driver of enhanced afterglow plasma chemistry in plasma jets with rare gas mixtures.

Brian Sands
UES, Inc.

Date submitted: 15 Jul 2011 Electronic form version 1.4