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Modeling of an Atmospheric Pressure Helium Plasma Jet DOUGLAS BREDEN, KENJI MIKI, LAXMINARAYAN RAJA, University of Texas at Austin — Cold atmospheric plasma jets have attracted great interest due to their potential application in fields such as biomedical surface modification. It is now well established that cold plasma jets produced by nanosecond pulsed discharges are in fact a series of rapidly propagating streamer discharges that have been termed "plasma bullets." The goal of this work is to elucidate the role that the diffusion zone, air-helium interactive chemistry and photoionization play in the physics of a single plasma bullet discharge. In this work, we perform several simulations with helium in a 3 mm diameter cavity and a mixed helium-air ambient excited by a 10 kV positive pulse. We utilize a self-consistent, multi-species, two-temperature plasma model with helium-air chemistry and a three-term Helmholtz photoionization model. It was found that the presence of air, which has a higher ionization threshold than helium is crucial to the formation of the bullet. The self-induced electric fields produced at the streamer head at the air-helium interface are what drive the propagation and give the bullet its distinctive ring shape. Although not crucial to bullet formation, including air photoionization resulted in streamer speeds almost twice those seen when photoionization is not included.

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