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IONIZATION WAVE PROPAGATION AND SURFACE INTERACTIONS IN A HE PLASMA JET*

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The ability of atmospheric pressure plasma jets (APPJs) to produce reactive oxygen and nitrogen species (RONS) for biomedical applications depends on control of the periodic ionization wave (IW) that propagates through the jet into the ambient. When treating surfaces, the need for control extends to the intersection of the IW with and propagation along the surface. In this paper, results will be discussed from optical diagnostics and computational modeling of a He APPJ in a controlled environment in which the IW contacts a dielectric surface. The APPJ is operated in a vacuum chamber which enables precise control of the helium purity, gas flow, ambient gas and surrounding electrical grounds. The jet consists of two concentric glass tubes – an inner tube in through which the IW propagates and an outer tube allowing a shrouding gas flow of different composition. The IW is produced with 400 ns, 6 kV pulse at a repetition rate of 1 kHz. Experiments were initially conducted at a reduced pressure of 200 Torr to facilitate pressure-sensitive diagnostics. The computer model is *nonPDPSIM*, a 2-dimensional plasma hydrodynamics model which includes modules for solving Boltzmann's equation for electron energy distributions, fluid dynamics, radiation transport, and the chemistry and transport of charged and neutral species [1]. Laser collisional induced fluorescence (LCIF) was used to measure the spatially and temporally resolved electron density, and ICCD imaging was used to study the IW propagation [2].

First the IW impinging on a dielectric in a pure He environment will be discussed. As the IW contacts the dielectric surface, a surface ionization wave (SIW) propagates radially outwards along the surface while charging the dielectric. The effect of pressure and applied voltage on IW propagation, and the use of a molecular gas in the shroud surrounding the gas flow is will also be discussed. Adding this molecular shrouding gas confines the IW to regions of higher helium mole fraction as it exits the tube and propagates toward the surface.

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2. E. V. Barnat and A. Fierro, "Ultrafast laser-collision-induced fluorescence in atmospheric pressure plasma", Journal of Physics D: Applied Physics **50**, 14LT01 (2017).

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