Abstract for an Invited Paper
for the DPP09 Meeting of
The American Physical Society

Cold microplasmas at one atmosphere: Simulation and characterization[1]

JEFFREY HOPWOOD, Tufts University

Cold atmospheric pressure plasma offers many of the same technical advantages as conventional low pressure glow discharges, but without the need for a vacuum system. The cold atmospheric plasma is distinct from most high-pressure plasmas, such as arcs and sparks, because the low gas temperature allows for the treatment of temperature sensitive materials. This talk focuses on the generation of microwave-frequency microplasmas of air and inert gases. These plasmas exhibit gas temperatures of 300-600 K, but electron temperatures of 1-2x10^4 K. The electron density is greater than 10^{14} cm^{-3}. Microplasma is generated in a 200 micron-wide gap in a ring-shaped microstrip transmission line. When operated at electrical resonance, a microwave potential forms across the discharge gap and generates a microplasma. Microplasma generation becomes more efficient at higher frequencies. Inert gas microplasmas are characterized using excitation frequencies of 450 MHz, 900 MHz, and 1.8 GHz at both 1 atm and 0.5 mbar. The microplasma resistance decreases with increasing frequency. Simultaneously, the reactive sheath impedance and the microwave electrode voltage also decrease. At higher microwave frequency, the decreased electrode voltage reduces both the plasma potential and the ion kinetic energy losses, thus increasing the electron density. A three-dimensional fluid model confirms these experimental measurements.

[1]This research is supported by the National Science Foundation under Grant No. CBET-0755761 and the Agilent Foundation.