Simulation of Atmospheric Air Micro Plasma Jet for Biomedical Applications

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Abstract

Small-scale plasma jets in atmospheric air can produce regions of highly reactive chemistry coincident with temperatures approaching room temperature allowing his type of cold plasma jet to be used for decontamination of surfaces and sterilization of living tissue. In the device under consideration in this work, atmospheric pressure air is forced through a hollow anode and cathode. Immediately prior to exiting the device, the air is subjected to a strong electric field, resulting in a plasma jet. The small diameter of the plasma and the turbulent heat transfer in the flow facilitate a low jet temperature, while reactive species continue to exist for some distance away from the nozzle. Due to the strong coupling between the electric field, fluid flow, physical kinetics, chemical reactions, and heat transfer, the simulation of plasma jets is a challenging multiphysics problem. A fully coupled plasma, fluid flow, and heat transfer analysis of the plasma jet has been conducted using COMSOL Multiphysics, and the simulation results predict the temperature distribution and the concentrations of reactive species within the jet. These results enable the design of a plasma jet operation to maximize the effectiveness of surface treatment while maintaining a sufficiently low temperature to avoid damaging sensitive surfaces.

Figures used in the abstract

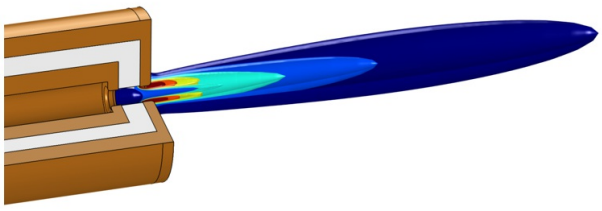

Figure 1: Figure 1: Temperature distribution associated with micro plasma jet