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Abstract

Plasma gasification of biomass is emerging as an efficient way to reduce the carbon foot print of waste management while producing renewable energy. In general, gasification processes heats waste to a temperature at which it is partially ionized and converted to synthesis gas (syngas). A negative byproduct of gasification is tar which shortens component life of gensets that convert the syngas into electricity. A 2.45 GHz microwave driven plasma (MDP) gasification process is examined as a way to improve the conversion efficiency and reduce tar content of syngas. Simulation of the MDP process opens new doors for the optimization of this green technology. The first step in simulating is validating an experiment already conducted to prove that boundary conditions and initial conditions are set correctly. From there the optimization process can start. The Input parameters of this system are microwave power, plasma properties, plasma carrier flow rate, frequency, and plasma carrier gas. The plasma modeled is characterized as non- ECR plasma as it exists in atmospheric pressure. The mode of propagation of interest in this case is TE mode. The simulation is performed using the Microwave Plasma interface to model wave heated discharges. From the application gallery In-Plane Microwave Plasma, Atmospheric Pressure Corona Discharge in Air, Oxygen Boltzmann Analysis, and Argon Boltzmann Analysis were referenced. An experimental design using the geometric constraints defined in a similar model will further validate MDP system design and provide a foundation for more efficient future commercial designs. The expected results from the simulations would be a proportional relationship between plasma power, intensity, and volume of the plasma. More specifically the plasma flame diameter and length increase, and the overall shape of the plasma changes from a spreading to pointed end. Another important result is that flow rate effects plasma flame size, volume, and intensity inversely.

Figures used in the abstract

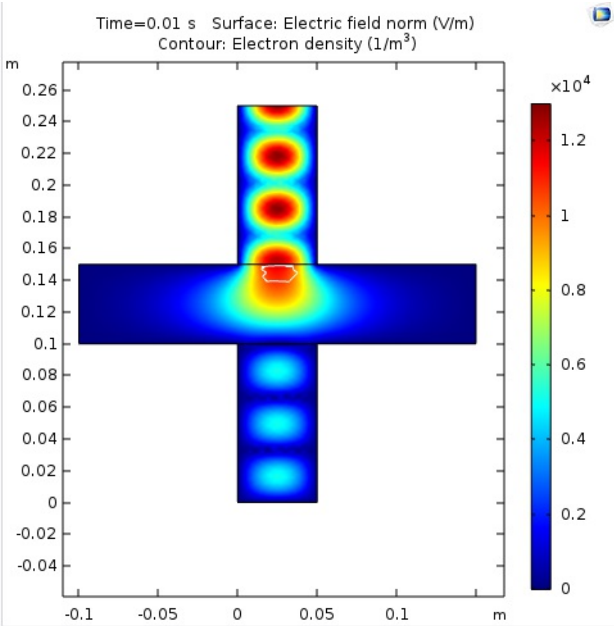

Figure 1: Electric Field is an important factor regarding ignition of the plasma flame and sustainability. When critical electron density is reached, waves no longer penetrate that area.