Demonstration of an Atmospheric Pressure Capacitively-Coupled-Plasma driven at VHF(162MHz) for Recycling of CO_2 into Renewable Fuels

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The recycling of carbon dioxideinto useful synthetic gases has attracted intense interest due to the growingconcerns for global climate change. The highest energy-step process in this‘closed-cycle’, renewable, liquid-carbon fuel is the CO_2 àCO step. It has been shown that the most energy efficient way to dissociate aCO_2 molecule is by vibrational excitation (and not direct electronictransitions). Therefore, cold non-thermal plasmas arethe most promising candidates because of their non-equilibrium nature.Here, we present a 162MHz driven atmospheric-pressure CCP, with top and bottomelectrodes operated in a push-pull configuration, powered via aPower-Splitting-Transmission-Line-Device (PSTLD). Absorbed power into thesystem is determined by measuring the phase shift between current (~10’s Amps)and voltages (~10’s Volts) waveforms at the electrode. Optical emissionspectroscopy results confirm a highly non-equilibrium plasma, with vibrationaltemperatures (from N_2) in the range ~ 7000K, even at very low powers,while gas temperature, monitored by a thermocouple at the gas outlet, remainslow </≈ 300K. Theamount of CO, as a product of CO_2 dissociation, is measured byoptical actinometry with N_2 as the actinometer. Our preliminaryfindings show that the production of CO increases initially with applied power,before saturation at higher powers, and a lower CO_2 flow rate, i.e.residence time, is optimal.