REFORMING AND FIXATION OF CARBON OXIDES IN ATMOSPHERIC PRESSURE NON-THERMAL CO/CO2 PLASMAS

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Climate change concerns and the desire for chemical storage of alternative energy sources have increased interest in finding efficient techniques for the dissociation and sequestration of carbon dioxide. Here we study the chemical kinetics and role of non-equilibrium plasma conditions in the conversion of carbon oxides from one form to another. Namely the dissociation of CO2 to CO and the polymerization of CO to C3O2 (Carbon suboxide, C3O2 is a little known oxide of carbon which is solid and stable at ambient conditions.) With such knowledge new and attractive utilizations of CO2 may be realized. In the dissociation of CO, theory suggests that non-thermal plasmas will be more efficient than thermal techniques (48kJ/mol vs. 340kJ/mol). With gas chromatography measurements of produced gases, time resolved power measurements and emission spectroscopy measurements of non-equilibrium temperatures we are investigating the kinetics and efficiencies of carbon dioxide dissociation. Solid deposition of carbon oxides is known to occur in plasma discharges in carbon monoxide.[1] C3O2 may be useful as a carbon fixation technology and also in the creation of storable, carbon neutral, solid fuels. Historically the deposits have been observed in low pressure plasma discharges; using a dielectric barrier discharge (DBD) we show that it is also possible for such depositions to readily take place at atmospheric pressure.

Measurements of deposition rate, properties of the polymer, and conditions of deposition are used to help understand the kinetic and energy balance for formation of these deposits. Figure 1 below shows an image and FTIR of the deposit. The composition of the deposits consist of both carbon and oxygen with structures resembling graphite and carbon suboxide polymer.

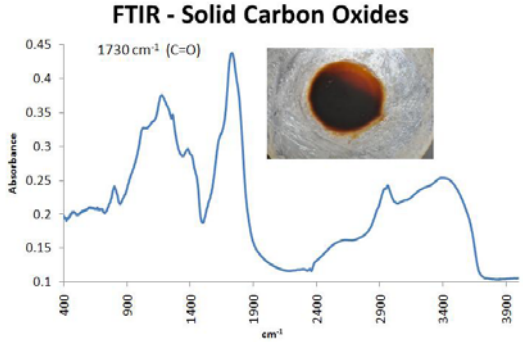

Figure 1: FTIR of solid carbon oxides deposits.

1. K. Jogan, et al., IEEE transactions on industry applications, VOL. 29, NO. 5, (1993)
2 L.H. Reyerson, Kenneth Kobe, Chemical Reviews, 7(4), 47 9-492 (1930)