Catalysts and Electrodes for the Electrochemical Reduction of CO_2 to CO

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Molly Jhong from Prof. Paul Kenis' group from the University of Illinois at Urbana-Champaign will present "Catalysts and Electrodes for the Electrochemical Reduction of CO_2 to CO." They have developed an electrochemical flow reactor for CO_2 reduction, in which the anode and cathode are separated by a flowing liquid electrolyte. They will show how catalyst particle size has a profound effect on the amount of CO formed, both in three-electrode electrochemical studies and in an electrochemical flow reactor. They reported that the reaction rate of the reduction of CO_2 to CO increases as the particle size decreases from 200 to 5 nm, but then shrinks again as the particle size decreases to 1 nm. Such typical volcano behavior can be mostly explained by the differences in binding energy of intermediates by particles of different size. In addition to fundamental studies on the catalyst particle size effect, they have collaborated with research groups within the I2CNER such as Prof. Andrew Gewirth, Prof. Naotoshi Nakashima, Prof. Tsuyohiko Fujigaya, and Prof. Stephen Lyth to develop new catalysts with high activity and stability. From a manufacturing standpoint, they will also show optimization of the structure of the catalyst layer by choosing the best catalyst layer deposition method (*e.g.*, fully-automated air-brushing) allowed for a 10-fold reduction in catalyst loading, while simultaneously improving current densities and product yields (high selectivity for CO). A thin, uniformly distributed, and agglomerate-free catalyst layer is key because it eliminates mass transport issues, while avoiding hydrogen evolution on bare carbon in the underlying gas diffusion layer. Comparison of their data with those reported by others shows that Kenis and coworkers (i) reach the same current densities and same energetic efficiencies at much lower cell potentials, while (ii) achieving much better Faradaic efficiency (selectivity for CO). In summary, they will show that rational catalyst and electrode design leads to significant improvements in performance, helping electrochemical CO_2 conversion to become a more economically feasible process.

Figure 1. Picture of the electrochemical flow reactor for the electrochemical reduction of CO_2.

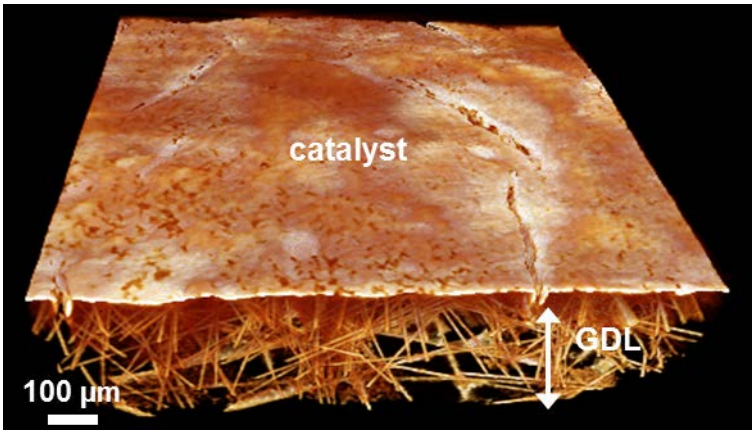

Figure 2. Micro-computed 3D tomographic image of the air-brushed cathode for the electrochemical reduction of CO_2 to CO that shows the thin uniformly distributed catalyst layer.