Microchemical Systems for Carbon Dioxide Conversion and Pharmaceutical / Protein Crystallization

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Abstract

Microchemical systems have been developed for applications ranging from clinical, diagnostic, and environmental tests to chemical / energy conversion. In this seminar I will first highlight our recent efforts in *the conversion of CO_2 into value-added chemicals*. Significant reductions in CO_2 emissions and the further development of alternative energy sources are critical to both minimize green-house gas effects and to reduce our dependence on fossil fuels. We are studying the efficient electrochemical conversion of CO_2 into (1) C1 fuels such as formic acid or methanol to enable storage of electrical energy in chemical form and (2) into intermediates such as CO to enable the synthesis of higher hydrocarbon fuels or fine chemicals, for example via the Fischer-Tropsch process. We have explored a range of catalyst and electrolyte compositions to improve the Faradaic efficiency (selectivity) and throughput of this electrochemical process. For example, we have shown that ionic liquids in the electrolyte can act as co-catalyst to stabilize the intermediate of the rate-limiting step, resulting in a drop of the overpotential from 0.77V to less than 0.2V (Science 2011).

The second part of this seminar will focus on *microscale platforms for crystallization of proteins and pharmaceuticals*. In order to drastically reduce the amount of material needed, and to eliminate manual handling of fragile crystals, we have developed and validated microfluidic array chips to screen for suitable crystallization conditions of (membrane) proteins, followed by on-chip X-ray structure determination. We successfully elucidated the structure of several new protein targets. The use of similar chips for solid form screening (salts, polymorphs, …) of candidate drugs as part of the drug development process will also be discussed.

Time permitting, a few other topics will be reviewed briefly, *e.g.,* radiolabelling of biomolecules for PET imaging, sensors for intracellular redox monitoring, and platforms for antibiotic screening/virus detection.

Friday, October 19th
LMC 101
3:00 – 4:00 pm