INORGANIC CHEMISTRY SEMINAR

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"Enhanced Gas Transport in Hybrid Bio-Inorganic CO_2 and N_2 Fixation Systems"

Abstract: With the surge of intermittent, renewable electricity, the storage of excessive electricity and reduction of CO_2 or N_2 into value-added chemicals is of great significance for a sustainable society. One viable route is to construct a hybrid inorganic-biological system that converts electricity into chemical energy and reduces CO_2/N_2 into commodity chemicals. In this general approach, water is electrochemically split into H_2 and O_2 and the yielded H_2 is consumed by microbes as a reducing equivalent for CO_2/N_2 reduction. This system has demonstrated high efficiencies however, the output of the commodity chemicals is limited by the supply of the reducing equivalent, H_2, within the system. While we can electrochemically control the rate of H_2 production, the poor solubility of H_2 in the aqueous environment results in a bottleneck. Here, we demonstrate the addition of perfluorocarbon (PFC) nanoemulsions to increase H_2 solubility and improve the kinetic rate of gas transport to the microbes for enhanced chemical production. With PFC nanoemulsions applied to our hybrid CO_2 fixation system, we maintained nearly 100% Faradaic efficiency over a range of applied current densities and increased the throughput 2.9 times at 2.0 mA/cm^2. Similarly, by adding varying percentages of PFC nanoemulsion to our N_2 fixation system we were able to control the H_2 and O_2 concentrations in solution and enhance N_2 fixation. Overall, our research demonstrates the use of PFC nanoemulsions to enhance gas solubility and gas transport in aqueous solution for favorable reaction conditions and improved rates of chemical production.

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4:00 p.m. | Via Zoom

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