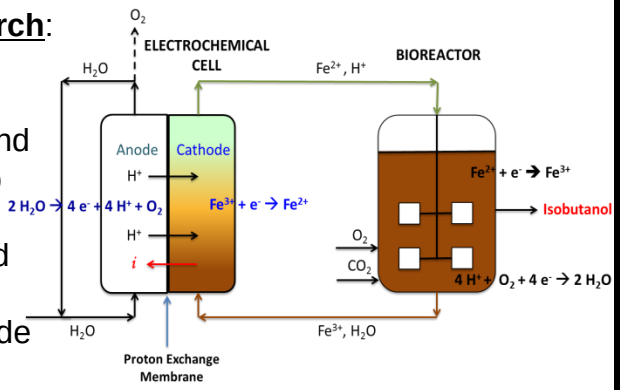
Electrochemical Reduction of Iron for Non-Photosynthetic Production of Biofuels from CO_2

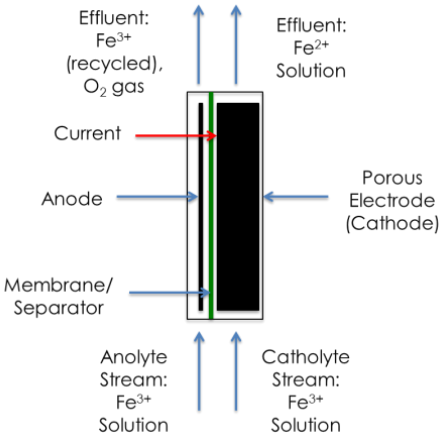
Objective: Design and optimize an integrated electrochemical/bioreactor process for the synthesis of isobutanol from iron-oxidizing bacteria, A. ferrooxidans.

Description of Research: Use linear sweep voltammetry, chronoamperometry, and chronopotentiometry to characterize the iron reduction in engineered media as well as the performance of electrode materials.



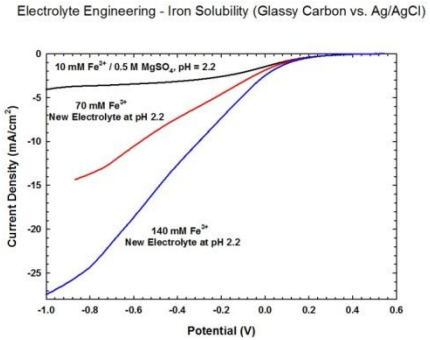
Major Challenges: Engineering the media to be optimal for both the growth of A. ferrooxidans in the bioreactor and operation of the electrochemical reactor. Optimizing the different parameters in the reactor for efficient reduction of ferric ions.

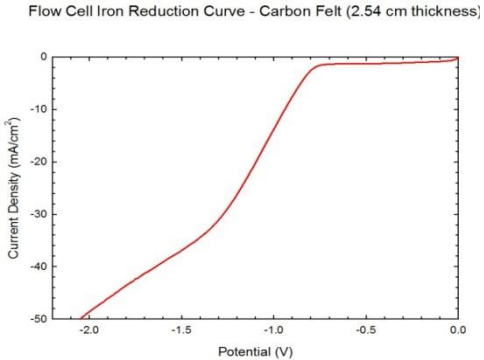
Main Questions: How do we overcome the iron solubility limit to reach high concentrations at pH 2? What is the best design for the flow cell electrochemical reactor? How do we optimize flow rates and configuration, electrode and membrane materials, long-term performance?



Results: It has been found that the use of a chelating agent allows for the stabilization of ferric ions in solution. This circumvents the solubility issues in the system and avoids the formation of unwanted precipitates.

High surface area porous electrodes such as carbon felts are optimal for this reduction process to achieve high current densities at low overpotentials.





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