

Enzymatic and Microbial Bioelectrocatalysis for Electrosynthesis

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In the last 5 years, there have been extensive studies and new materials designed for catalytic reduction of nitrogen to ammonia. This is a very difficult reductive transformation for traditional electrocatalysts and photocatalysts, but nature can provide an inspiration. Nitrogenase is the only enzyme known to reduce nitrogen to ammonia. This intriguing enzyme is typically studied by a range of spectroscopies and due to the complexity of the nitrogenase system (including the dynamics of both a catalytic protein containing a FeMo-cofactor and an Fe protein), it is hard to directly study enzyme mechanism with standard spectroscopic techniques and assays. This talk will discuss electroanalytical techniques for studying the enzyme mechanism of nitrogenase, including both mediated bioelectrocatalysis and direct bioelectrocatalysis. Then, this talk will discuss electrode materials innovation for interfacing these complex proteins with electrode surfaces as well as using them for electrosynthesis of ammonia as well as other value-added products (i.e. chiral amines, chiral amino acids, etc.). Finally, this talk will discuss the use of synthetic biology for microbial bioelectrosynthesis of ammonia and other value-added products.