Title	**Electrochemical conversion of carbon dioxide to formic acid on nanostructured electrocatalysts**
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Project description:

The reduction of CO_2 global emissions through its efficient transformation into more valuable chemicals would have a huge impact in the current efforts to meet the environmental and climate goals of the European Green Deal. The electrochemical reduction of CO_2, $ERCO_2$, is considered one of the most promising strategies to convert waste-CO_2 to value-added chemicals, such as CO, formic acid, methanol, methane, etc. A large variety of heterogeneous and homogeneous catalytic systems have been employed for ERCO2 to produce various products. However, the current CO_2 reduction technologies are plagued by poor selectivity for valuable products and low cell efficiency.

The aim of this research project is to develop an economic and efficient $ERCO_2$ route to formic acid, using tin-based electrodes. Sn is one of the best electrode materials for CO_2 reduction to formic acid but the electrochemical process suffers from various drawbacks including low CO_2 solubility in water, low current density, high energy consumption and low final FA concentration. Various strategies will be explored to overcome these problems:

- To enhance the cell current highly porous Sn foam electrodes and Sn-doped high surface area nitrogen-enriched mesoporous carbons (NMCs) will be prepared and utilized as cathodes. NMCs and Sn-doped NMCs will be prepared via soft-template synthesis from copolymers prepared by electrochemically-mediated atom transfer radical polymerization. Preparation of Sn foam electrodes with highly porous nanostructured walls will be based on electrodeposition via the hydrogen bubble dynamic template method.
- Two approaches will be considered to increase CO_2 concentration in solution: (i) utilization of pressurized electrochemical cells and (ii) a change of reaction medium from pure water to organic solvent/water mixtures.
- To improve the economics of the process, the commonly used oxidation of water at the anode will be replaced with a valuable oxidation reaction (paired electrolysis) such as anodic conversion of methanol to formic acid.