

# SEMS: RESEARCH PROJECT DESCRIPTION

## 1. Project Background and Description

*A project title and description with clear aims (300 words)*

*Project Title: **New Sustainable Materials for CO<sub>2</sub> Electrochemical Reduction***

*The growing level of CO<sub>2</sub> in our atmosphere is one of major challenges our society has to battle. Because of that, there is a pressing need to advance the conversion of CO<sub>2</sub> into useful products via electrochemical reduction, such as carbon monoxide, formic acid, methane, ethanol and others. The main challenge comes from the inertness of CO<sub>2</sub>, which requires the use of catalysts for its electrochemical conversion. Among the non-noble metal catalysts, copper materials in particular have been extensively researched for this application. However, Cu-based catalysts still operate at relatively high overpotentials to be viable. This PhD project will look into strategies to design low-cost sustainable catalysts for the electrochemical reduction of CO<sub>2</sub>. Metal-coupling, nanostructuring and the use of metal-organic frameworks are envisaged as strategies for producing high performing materials for CO<sub>2</sub> conversion. During the course of the project, suitable materials will be identified, prepared and characterized, in terms of their structure and electrochemical properties. For this, an extensive number of techniques available at QMUL will be used, including Raman spectroscopy, FTIR, TEM, SEM, XPS, BET, AFM, TGA and XRD. The new electrodes will be tested for the electrochemical reduction of CO<sub>2</sub> into different products. Electrochemical techniques, including cyclic voltammetry, chronoamperometry, chronopotentiometry and electrochemical impedance spectroscopy will be conducted. New in situ and operando electrochemical cells will be designed to understand the structure-property relationships. This PhD project will produce a new generation of highly active materials for CO<sub>2</sub> reduction and will bring new understanding to the electronic mechanisms taking place in these systems.*

## 2. Project Scope

*Three research project objectives*

- *Synthesis and optimization of highly active electrode materials with controlled morphology, composition and structural features*
- *Structural characterization and testing of electrochemical properties to gain a deep understanding of the structure-property relationships in these materials*
- *Design of in situ and operando experiments that can help unravel the electrocatalytic mechanism of CO<sub>2</sub> reduction in the electrodes prepared*

## 3. Desired Skills from the Student

*Key skills needed for the PhD project*

*The project would suit graduates from a chemistry or materials science background. Strong understanding of chemistry methods (synthesis and analysis). Motivated and driven.*

## 4. Supervisory Team

*Add supervisory team details*

*Primary: (Name (inc title)). **Dr Ana Jorge Sobrido***

Secondary: (Name (inc title)/ department or company if outside SEMS). **Dr Petra Szilagy**