Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Fully funded PhD Position:
CO_2 Electrocatalysis on Individual Bimetallic Nanoparticles

Overview: A fully funded studentship is available with Prof. Kim McKelvey in the School of Chemistry at Trinity College Dublin. The project aims to use nanoscale electrochemical techniques to understand CO_2 electrocatalysis on individual bimetallic nanoparticles.

Background: The burning of fossil fuels (such as coal, oil and gas) has resulted in the drastic increase in atmospheric carbon dioxide (CO_2) levels, which has caused global warming and climate change. One possible method to reduce CO_2 emissions into the atmosphere is to capture CO_2 produced by fossil-fuel-burning power plants and turn it into useful products, for example liquid fuels like ethanol.

The conversion of CO_2 to liquid fuels can be achieved using electrochemistry. Electrical energy is used to drive a chemical reaction at the surface of an electrode that turns CO_2 into carbon monoxide, ethylene, ethanol or n-propanol. How quickly this reaction proceeds depends on the properties of the electrode, with changes in the type of material or the critically structure of the material leading to changes in performance.

One method to improve the performance of the CO_2 conversion reaction is to change the physical structure of the electrode surface, reducing the electrode to nanoparticles. Nanoparticles improve the performance of the CO_2 conversion reaction by exposing a much higher proportion of edges on which the reaction proceeds quicker. Different size and shape nanoparticles give different improvements in CO_2 conversion. However, it is incredibly difficult to measure the electrochemical response of a single nanoparticle because of small size and the corresponding small electrochemical current signal, but this is exactly what we intend to achieve for the very first time in this project.

Project: In this project we aim to understand how the efficiency of the CO_2 conversion reaction relates to the nanoparticle size and shape on single isolated bimetallic nanoparticles, in the hope of designing new electrochemical CO_2 conversion devices and developing new methods to study single nanoparticles. The student will synthesis bimetallic nanoparticles, characterize nanoparticle size and shape, and then use Scanning Electrochemical Cell Microscopy (SECCM) to isolate the electrochemical signal from single nanoparticles. At the end of the project the student will be an expert in nanoscale electrochemistry, electrocatalytic CO_2 reduction, and nanoscale characterisation methods. A range of physical chemistry techniques, such as atomic force microscopy, electron microscopy and electrochemical impedance spectroscopy will also be used. Full training will be given in all aspects of the project.

Research environment: You will work in a supportive research group in the Department of Chemistry (http://www.mckelveylab.com/). Our lab is in the Trinity Biomedical Sciences Institute and has links to CRANN and AMBER research centres. Trinity College Dublin and the School of Chemistry has a vibrant research community with world class research facilities. You will have opportunities to interact with other research groups within Trinity, within Ireland, and internationally. You will have the opportunity to attend and present at national and international conferences.

Requirements: Good university degree (1^{st} or 2:1) in Chemistry, Physics, Nanoscience or a related subject. You must be highly motivated and able to work independently and as part of a team. Good knowledge of physical chemistry and an interest in electrochemistry and research is required. Full training will be given in all aspects of the project.

Application: The position is fully funded (stipend & fees) and open to both EU and non-EU applicants. The position will begin in September 2019, applications will be accepted until the position is filled. For further information or to apply please email a cover letter and CV to **kim.mckelvey@tcd.ie**.