# 2020 HGF – OCPC – Programme

## for the involvement of postdocs in bilateral collaboration projects

**Title of the project:**

*In situ* spectroscopic investigation of (photo)electrochemical systems for carbon dioxide conversion

**Helmholtz Centre and institute:**

Helmholtz-Zentrum Berlin für Materialien und Energie GmbH

**Project leader:**

Matthew T. Mayer, Ph.D

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**Department:** (at the Helmholtz centre or Institute)

EE-NECC – Electrochemical Conversion of $CO_2$

**Programme Coordinator** (Email, telephone)

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**Description of the project** (max. 1 page)**:**

For mankind to end our dependence on fossil-based carbon for fuels and chemicals, carbon dioxide will need to become a primary carbon source. But $CO_2$ is a difficult molecule to activate, and its conversion requires significant energy input. Our research group uses renewable energy (sunlight or sunlight-derived electricity) to drive the (photo)electrochemical conversion of $CO_2$ into added-value products. These reactions can follow various pathways to form a number of different products, and fundamental research is required in order to better understand these mechanisms and to design better catalysts and processes.

This project will focus on developing methods for conducting structural studies *in situ* during electrochemistry, in order to elucidate structure-function relationships under operating conditions. The dynamic reaction conditions for $CO_2$ conversion systems complicate the interpretation of standard electro-analytical methods, so we aim to combine these methods together with various *in situ* spectroscopic techniques.

The target methods include: X-ray absorption/emission and photoelectron spectroscopy, IR and Raman spectroscopy, mass spectrometry, intensity-modulated photo-current/-voltage spectroscopy.

The researcher will develop reaction environments (e.g. flow cells) compatible with the methods, and conduct studies of model electrocatalyst and photocathode materials under $CO_2$ reduction conditions. This includes working with both laboratory and synchrotron-based instrumentation. Data acquired from *in situ* spectroscopy will be used to develop and validate reaction mechanism concepts, information which will be used for further advances in reaction selectivity, rate, and efficiency.

**Description of existing or sought Chinese collaboration partner institute** (max. half page)**:**

We seek a collaboration partner institute which has research efforts in the fields of chemistry, materials science, chemical engineering or related fields and conducts research on the topics of photoelectrochemistry and electrocatalysis. We would specifically value a partnership with an institute specializing in the development of spectroscopic methods applied *in situ* during electrocatalytic reactions. This could include experience with or access to synchrotron facilities, or other specialized facilities.

**Required qualification of the post-doc:**

- PhD in Chemistry, Materials Science, Chemical Engineering, or related field.
- Experience with electrocatalysis, photoelectrochemistry, and spectroscopy of materials is required.
- Additional skills in reactor design, synchrotron methods, and/or computational modelling would be valuable.
- Excellent verbal and written English skills, demonstrated by first-author publications.
- To demonstrate their abilities and interest, applicants should include in their application a brief proposal of a unique scientific question or idea relating to $CO_2$ conversion, with a succinct summary of how it could be addressed experimentally by *in situ* spectroscopic techniques.