Carbon-based catalysts for electrochemical H2O2 generation

School:
Chemical Engineering
Supervisory Team:
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Research Area:
Energy
Description of field of research:

Low-cost and efficient catalysts for on-site production of valuable chemicals, such as H2O2, is of great interest in chemical industry. In this project, carbon-based catalysts, particularly vertical graphene, will be implemented for electrochemical H2O2 production at high efficiency and selectivity. Vertical graphene shows unique structure of graphene nanosheets oriented perpendicularly to the substrate surface. Compared to random graphene nanoflakes, vertical graphene possesses advantageous features of large surface area, interconnected porosity, mechanical rigidity and electrochemically active edges. The project will investigate a number of structural factors in vertical graphene, such as surface wettability and functional groups, to achieve the optimised H2O2 production performance.

Research Environment

The student will have the opportunity to work in a highly prolific team in the PartCat Research Group at School of Chemical Engineering, under the guidance of Dr Zhaojun Han and Dr Xunyu Lu. He/she will also have the opportunity to interact with Sci. Prof. Rose Amal, director of the PartCat Research Group. In addition, the student could work with CSRIO, Australia's national research agency, and have access to industry-focused research environment.

Expected Outcomes

The student is expected to i) understand the electrochemical route of producing H2O2; ii) understand the role of vertical graphene in the catalytical process; iii) obtain hands-on experience in preparing the catalysts and setting up the electrochemical reaction cell; and iv) gain knowledge in evaluating the electrochemical performance of catalysts for H2O2 production.

Reference Material/Links

- Zhang, Q.; Tan, X.; Bedford, N. M.; Han, Z.; Thomsen, L.; Smith, S.; Amal, R.; Lu, X., Direct insights into the role of epoxy groups on cobalt sites for acidic H2O2 production. Nat. Comm. 2020, 11, 4181.
- Roman, D. S.; Krishnamurthy, D.; Garg, R.; Hafiz, H.; Lamparski, M.; Nuhfer, N. T.; Meunier, V.; Viswanathan, V.; Cohen-Karni, T., Engineering Three-Dimensional (3D) Out-of-Plane Graphene Edge Sites for Highly Selective Two-Electron Oxygen Reduction Electrocatalysis. ACS Catal. 2020, 10, 1993.