Recent Advances in the Electrocatalysis of Carbon Dioxide and Molecular Oxygen Electroreduction

Avanços Recentes na Eletrocatálise de Eletro-redução de Dióxido de Carbono e de Oxigênio Molecular

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Abstract: The electrochemical reduction of CO_2 is a promising strategy for producing fuels or gaseous reactants (such as syngas) for the chemical industry. The reaction selectivity can be controlled by different parameters, but it is mainly affected by the electrocatalyst and electrolyte [1]. In this presentation, attention will be given to the recent achievements for the selective electroreduction of CO_2 to $HCOO^-$ or CO, by selecting the electrocatalyst, according to its overpotential to the hydrogen evolution reaction, and by selecting the co-catalyst added to the aqueous electrolyte. The oxygen electroreduction is still responsible for large overpotentials (~ 0.4 V) of the fuel cell cathodes. Carbon-supported platinum nanoparticles present the highest activity among the pure metals, but its scarcity and high price hamper the fuel cell commercialization. Electrocatalysts formed by abundant components and non-noble metals are rising as efficient alternatives to platinum-based electrocatalysts, mainly after the discovery of new synthesis routes that produces active and stable materials. Two different structures have been identified as being active and stable for the oxygen electroreduction: (i) iron and/or cobalt metals coordinated by nitrogen atoms inserted in a carbon matrix nanostructure (Metal-N-C) and; (ii) nitrogen-doped carbon-encapsulated iron and/or cobalt nanoparticles (Metal@N-C). This presentation will also be focused on the main experimental advances related to the understanding of the composition/structure – activity/stability correlation for the oxygen reduction reaction.

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