Catalytic Activity of Carbon Nanotubes and Strapped Iron Porphyrin Hybrids for Oxygen Reduction Reaction

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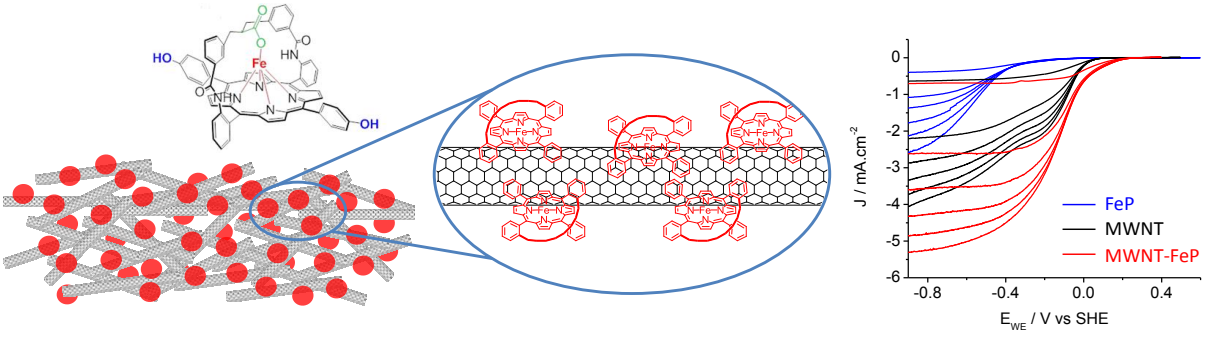
For the last decade, the development of non-noble metal or metal-free catalysts for hydrogen economy has been a field of growing interest. Among others, Hydrogen Evolving Reaction (HER), water splitting and Oxygen Reduction Reaction (ORR) are crucial reactions that must be well controlled to improve the production of hydrogen or to optimize the efficiency of fuel cells. The reduction of oxygen is the reaction that takes place at the cathode of a fuel cell, its slow kinetics, its multistep process and the competition between the two-electron and four-electron pathway make ORR the limiting reaction in fuel cells.[1,2] In nature, the reactions involving oxygen, like oxygen reduction, oxidation reaction, oxygen transport are often performed by iron porphyrins located in protein complexes. Cytochrome *c* Oxidase is a famous example of protein performing the reduction of oxygen; thus, bioinspired catalysts based on porphyrin and phthalocyanine derivatives, mimicking the structure of active center of the protein have been developed and extensively investigated for ORR.[3-6]

Here, we focus on the ORR activity of MWNT functionalized with iron (III) strapped-porphyrins. The porphyrins contain a bridge bearing one or two carboxylic functions between the phenyl groups in 5 and 15 *meso* positions. The overhanging bridge prevents the aggregation of the porphyrins and we assume that only one face is available to interact with the nanotubes by π-stacking. The electrocatalytic activity of several catalysts prepared with different mass ratio of MWNT/FeP was tested at different pH. The goal of this study is first to measure the ORR properties of strapped porphyrins bearing proton relay and second to evaluate the influence of the communication between the nanotube and the catalytic centers.



Representation of MWNT-porphyrin hybrids and comparison of ORR activity of the materials.

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