HIGHLY EFFICIENT OXYGEN REDUCTION AND OXYGEN EVOLUTION REACTIONS BIFUNCTIONAL CATALYSTS BASED ON METAL-FREE N- AND P-CONTAINING CARBON MATERIALS

Javier Quílez-Bermejo[1], Alessio Ghisolfi[1], Emilio San Fabián[2], Emilia Morallón[2], Diego Cazorla-Amorós[1]

[1]Departamento de Química Inorgánica and Instituto de Materiales. Universidad de Alicante, Ap. 99, 03080, Alicante, Spain.

[2]Departamento de Química Física and Instituto de Materiales. Universidad de Alicante, Ap. 99, 03080, Alicante, Spain.

Abstract

Both oxygen reduction and oxygen evolution reactions are key processes in different sustainable energy storage and generation devices. Nowadays, the best electrocatalysts for these reactions are based on noble metals (such as Pt, Ru or Ir). However, their high cost, low stability and low tolerance to carbon monoxide are very important drawbacks that limit the large large-scale commercialization of these devices. Thus, development of low cost and highly efficient bifunctional catalysts is mandatory.

However, this new kind of catalysts is still far from the high activity of the commercial catalysts. One of the most promising and challenging alternatives are carbon materials modified with heteroatoms that can create active sites for both reactions. In this sense, this work presents the synthesis of carbon materials containing both phosphorus and nitrogen moieties through the carbonization of P-modified polyaniline, which leads to materials with a promising activity towards oxygen reduction and oxygen evolution reactions. The presence of both nitrogen and phosphorus functionalities is necessary for achieving noble metal-like performance, as the experimental results and the computational DFT calculations demonstrate.