GRAPHENE-BASED ELECTROCATALYSTS WITH ENHANCED PERFORMANCE TOWARDS OXYGEN REDUCTION REACTION DECORATED WITH COBALT, IRON AND/OR TITANIUM

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ABSTRACT

The development of non-noble metal electrocatalysts towards the oxygen reduction reaction (ORR) is a key step to launch fuel cells (FCs) into the market. Carbon-based materials, such as graphene, have been proposed as an alternative to platinum group metals (PGMs) at the cathode of FCs because they are inexpensive, widely available and active towards ORR.

The modification of reduced graphene oxide (rGO) structure by doping procedures with heteroatoms (N, P, S, B) and with earth-abundant metals creates structural defects which can enhance the ORR activity. In particular, the creation of active sites formed by Me-N-C species (Me = Co/CoO, Fe, Ti, Mn, etc.), is highly related with an enhancement in the catalytic activity towards the ORR.

The aim of this work is the synthesis of nitrogen-doped rGO and its modification with Fe, Co and/or Ti nanoparticles. N-doped graphene has been obtained by thermal treatments of GO and urea at different temperatures. In order to compare the influence of the synthesis method, non-noble metals supported on rGO have been prepared by means of impregnation and reduction with sodium borohydride, and by direct reduction at high temperature.

The electrocatalysts have been characterized using X-ray diffraction, Raman spectroscopy, X-ray photoelectron spectroscopy and elemental analysis. The catalytic activity for the ORR has been measured using a three-electrode cell in alkaline medium (0.1M NaOH) with a rotating disk electrode (RDE). Initial results show that all catalysts present good onset potential for ORR, being cobalt-based catalysts those with the highest activity.