Innovative nanomaterial catalysts for ORR

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The easy, fast, eco-friendly and reliable method for the synthesis of innovative nitrogen-doped rGO-Metal (M) based catalysts (M=Mn, Cu) as cathode materials for fuel cell application is here presented. Different catalysts were prepared by one pot process, starting from graphene oxide (GO), which was reduced to graphene while the hydrothermal synthesis and functionalization were carried out in a microwave system. The prepared materials were carefully characterized by means of Field Emission Scanning Electron Microscopy, Transmission Electron Microscopy (Fig. 1) and X-ray Photoelectron Spectroscopy. The absence of crystalline structures confirmed the single metal atom functionalization of the carbon lattice. Thanks to the comparison between experimental and simulated Extended X-Ray Absorption Fine Structure spectra with Density Functional Theory calculations, the fine molecular structure responsible for the high electrocatalytic activity toward ORR has been uniquely identified and characterized. Various electrochemical techniques (Cyclic voltammetry, Rotating Ring Disk Electrode, Electrochemical Impedance Spectroscopy, Linear Sweep Voltammetry and Chronoamperometry) were employed to evaluate the activity and durability of the as prepared electrocatalysts for ORR in alkaline solution. These characterizations put in evidence the ability of all the obtained materials to be effective catalysts, exploiting a co-catalysis mechanism provided by the presence of both metal and nitrogen atoms in the carbon lattice. Outstanding ORR performances[1,2], near the theoretical optimum value, were obtained.

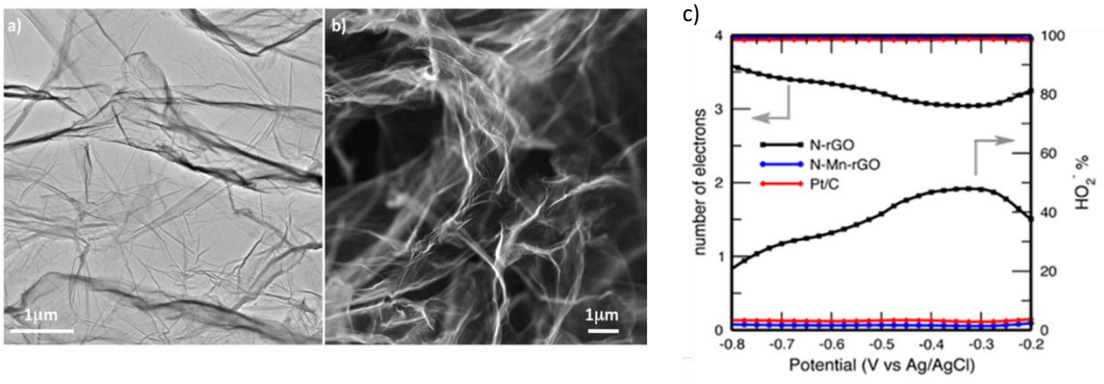

Fig. 1. Electron microscopy characterization of Mn-N-rGO sample: (a) TEM, (b) STEM images (c) Results of electrochemical measurements.

Keywords: reduced graphene oxide, ORR, microwave, novel catalysts

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