ELECTRONIC SUPPLEMENTARY INFORMATION

Integrative structural and advanced imaging characterization of manganese oxide nanotubes doped with cobaltite

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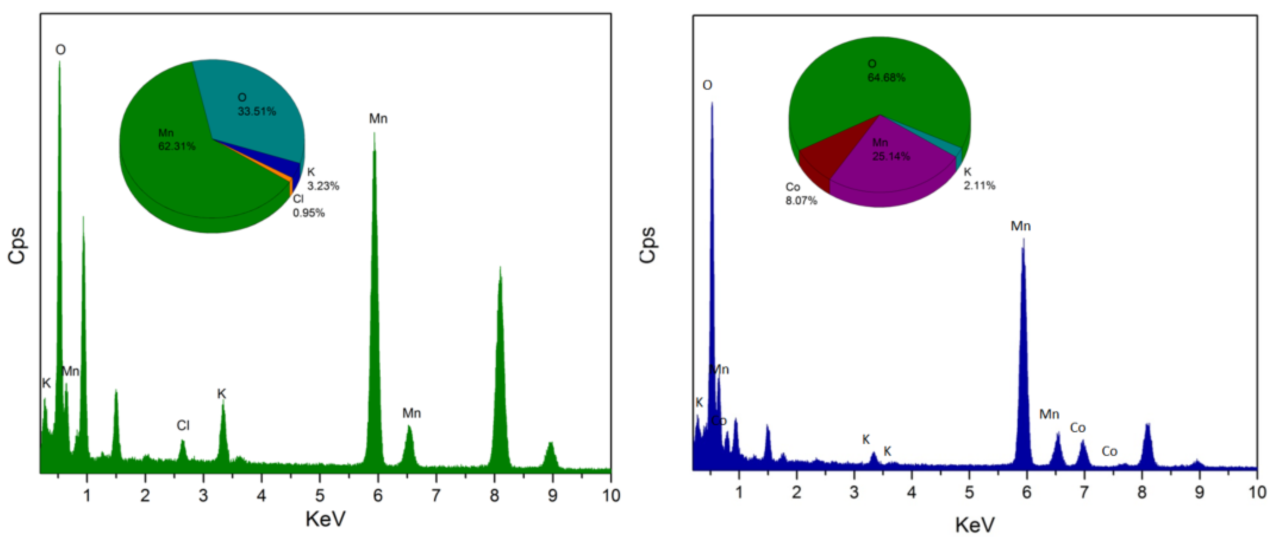

Figure S1. Energy Disperse X-Ray Spectroscopy. EDX analysis of the MnO_2 nanotubes, left, and MnO_2 nanotubes decorated with the Co_3O_4 nanoparticles, right.

EDX spectrum of the MnONT and MnONT+Co_3O_4, left and right respectively, samples analyzed with UHR-FE-SEM HITACHI S5500. In the left spectrum it was clearly appreciated the presence of the characteristic peaks of Mn (0.64, 5.90 and 6.49 keV), O (0.526 keV) and K (3.31 and 3.59

keV), which corresponded to the chemical composition of the nanotubes, and the peaks of Cl from the synthesis process. In the spectrum of the MnONT+Co_3O_4, the peaks corresponding to the Mn, O and K remained, but the presence of two news peaks at 6.93 and 7.65 was observed. Those peaks corresponded to Co from the doping nanoparticles. Additional peaks in both spectra at 0.95, 8.05 and 8.90 keV corresponded to the copper grid, whereas the peak at 1.49 keV to the Al signal of the grid and TEM holder.

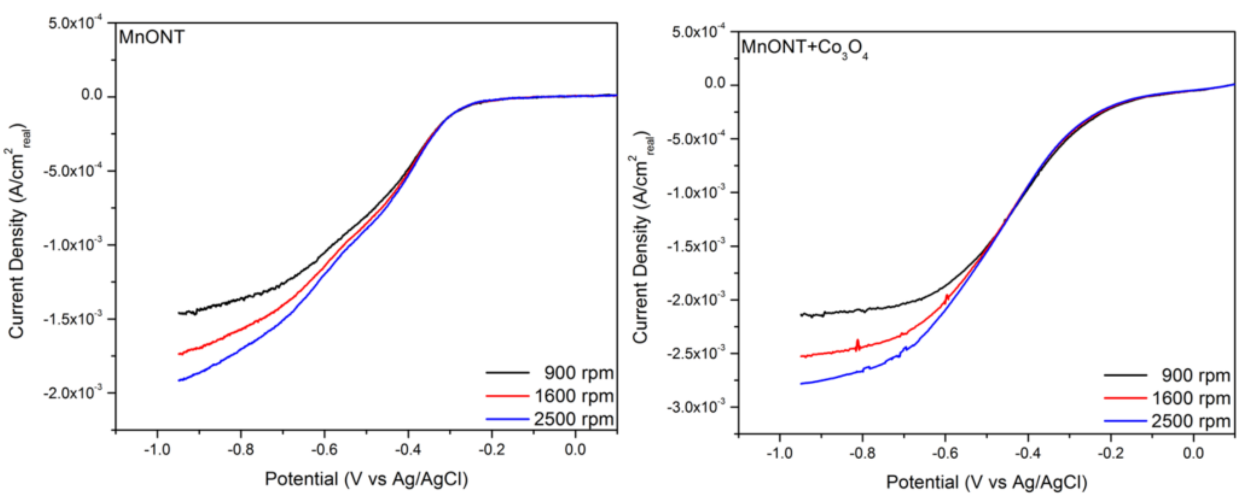

Figure. S2. Linear Scanning Voltammograms. LSV's measurements of the MnONT (left) and MnONT+Co_3O_4 (right) at 900, 1600 and 2500 rpm in a O_2 saturated solution.

LSV's measurements of both samples in KOH 0.1 M solution saturated with O_2. The first difference of both samples that could be observed was the current density reached. For MnONT reached values of $1.41x10^{-3}$, $1.64x10^{-3}$ y $1.8x10^{-3}$ A/cm^2 at 900, 1600 and 2500 rpm, respectively. Whereas in the case of MnONT+Co_3O_4 reached values of $2.11x10^{-3}$, $2.48x10^{-3}$ and $2.71x10^{-3}$ A/cm^2 for the same velocities tested. Another difference between the materials was the onset potential of the reaction; the current droping in the MnONT began after 0.3 V while in the MnONT+Co_3O_4 began around 0.2 V. The differences between these responses of the materials confirmed that MnON+Co_3O_4 composite material had a higher activity in the presence of oxygen in the solution, in contrast with MnONT material.

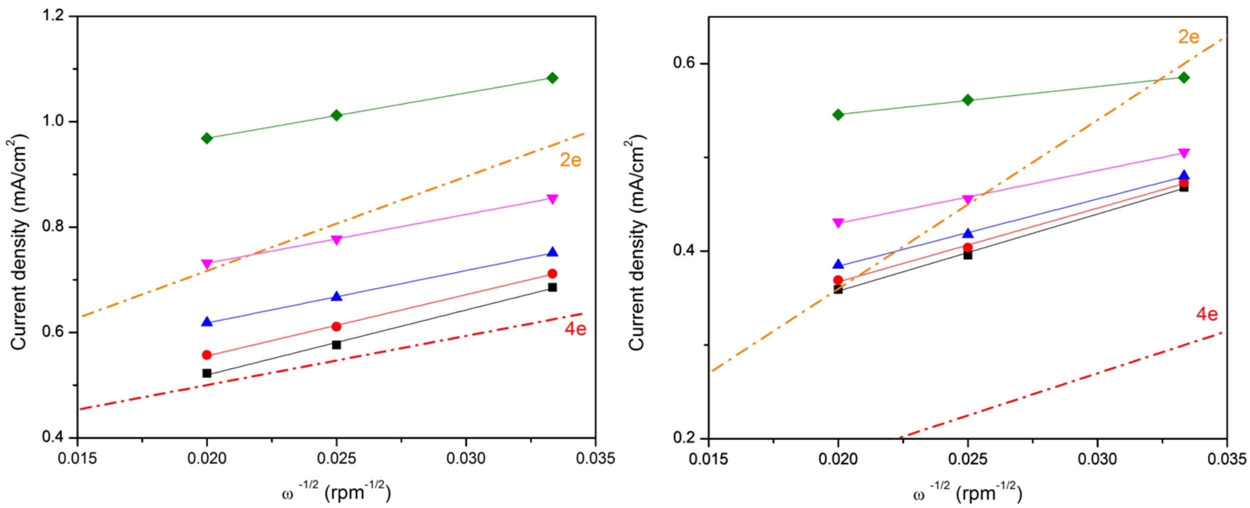

Figure. S3. Koutecky-Levich. Koutecky-Levich plots of ORR for the MnONT (left) and MnONT+Co_3O_4 (right) samples.

Koutecky-Levich plots of the MnONT (left) and MnONT+Co_3O_4 (right) materials. In both graphical voltages of 1, 0.9, 0.8 and 0.7 V were analyzed (black, red, blue, pink and green points respetively) and the theoretical slopes corresponding to 2e and 4e lines are showed (red and orange lines). Both graphs of all analyzed points followed a similar behavior and with similar tendency in comparison with the theoretical lines for both materials, presenting slopes similar to the 4e theoretical line.