Tailored MnO_2 Nanoparticles as Electrocatalysts for Metal-Air Batteries

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In next-generation electronics, electrified transportation and energy storage, metal-air batteries represent one class of promising power sources thanks to their remarkably high theoretical energy and light weight [1]. The main feature of metal-air batteries is the combination of a metal anode with high energy density and an air electrode with open structure that facilitates the drawing of cathode active materials (*i.e.* oxygen) from air [1]. In these types of devices, Gas Diffusion Electrodes (GDEs) are widely used as cathodes [2]. However, one of the main drawbacks related to the cathodic reaction (ORR) is the overpotential loss (about 0.3-0.4 V) under operative conditions. Thus, lots of efforts were spent to inhibit the voltage loss requiring an effective ORR catalyst [1,3]. One of the most promising materials, in terms of both performances and costs, seems to be MnOx. According to the recent literature, MnO_2 would ensure capacities comparable to those of platinum, letting higher capacity retention to be reached in non-aqueous electrolytes to prevent Li decomposition [1].
In the present work, the electrochemical performances of either bare or Fe/Co-doped MnO_2 nano-electrocatalysts are evaluated by Linear Sweep Voltammetries (LSVs). The crystal structure and the surface properties are examined by means of XRPD, BET-BJH, TEM, SEM/EDX and XPS analyses. Correlations between their physico-chemical features and the final electrocatalytic performances are drawn. Experimental results reveal that the as-synthesized powders have excellent electrochemical properties in organic electrolytes (0.15 M $LiNO_3$ in propylene carbonate, PC) showing a shift of the onset potential of about 150 mV with 2% Co-doped MnO_2, thus resulting very promising candidates to be used in lithium-air batteries [4].

References

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