

Modification of carbon supports for promotion the oxygen reduction reaction over spinel electrocatalysts

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Rapid development of energy consumption combined with a growing ecological consciousness has promoted a wide-ranging search for eco-friendly energy sources. Design and synthesis of highly efficient electrocatalysts to facilitate sluggish oxygen reduction reaction (ORR) is, therefore, a key issue in the context of full commercialization of fuel cells. Transition metal oxides of spinel structure represent an interesting group of potential catalysts that may substitute the widely used Pt based materials. Due to low electrical conductivity and tendency to undesired aggregation of the spinel nanoparticles, it is important to support them on the appropriate carbon carriers. Modification of the carbon lattice with heteroelements or/and incorporation of oxygen-containing functionalities onto the carbon surface are regarded as an efficient method to enhance the interaction of nanoparticles with the support and improve the electrical conductivity. Our research focus on determination of the influence of the carbon supports modification on the catalytic activity and the ORR mechanism catalyzed by the nanometric spinel with a different composition (Co, Mn, Fe). The catalytic properties of well-characterized materials were studied by rotating disk electrode (RDE) and rotating ring-disk electrode (RRDE) methods. The catalytic performance of spinel catalysts is found to depend strongly on both the spinel composition and the nanocrystal morphology as well as on the chemical nature of the carbon supports. Modification of the mesoporous carbon lattice by the incorporation of nitrogen and sulphur led to enhancement of crystallinity of the carrier, which improves the ORR activity and selectivity towards the desired $4e^-$ dioxygen reduction pathway.