Abstract

Like a Phoenix from the Ashes: Magnesium Chloride Activated Carbons as Novel Support Materials for Highly Active Non-Precious Fuel Cell Catalysts

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Polymer electrolyte membrane fuel cells (PEMFC) are amongst the most promising energy conversion technologies today. Herein non-precious iron-coordinated nitrogen-doped carbons (Fe-N-Cs) are very promising alternatives for expensive Pt-based cathode catalysts.[1-3] The preparation of these catalysts was strongly optimized over the years; still they remain with harsh reaction conditions that complicate the selective formation of active FeN_4 sites. The employment of pyrolytic temperatures has been a dogma for the synthesis of FeN_4 sites, however coming with unfavorable side reactions.

We recently introduced a mild procedure, which is conservative toward the carbon support and leads to active-site formation at low temperatures in a wet-chemical coordination step, essentially decoupling the preparation of nitrogen-doped carbons (NDCs) from the preparation of the active sites.

The key concept for the success is the so-called *active-site imprinting* into the NDC before the involvement of iron. We developed a synthesis, reminiscent of activated carbon preparation, using $MgCl_2$ as activating agent. The obtained carbons have large tubular porosity and the Lewis-acidic Mg^{2+} results in formation MgN_4 sites. The remains of the salt, often denoted as "ash content" therefore directly relate to imprinted active-sites. Exchange of Mg with Fe leads to very active catalysts with a half-wave potential of up to 0.76 V *vs.* RHE in acid. The catalyst shows $4e^-$ selectivity and exceptional stability. Spectroscopic results prove the formation of active and stable FeN_4 sites at 80 °C.[5]

References:

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