Templated rapeseed press cake based materials as efficient oxygen reduction reaction electrocatalysts

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Low-temperature fuel cells are among the most promising solutions for clean energy, but dependence on expensive Pt-based catalysts hinders the widespread deployment of these devices. Great efforts have been made to develop active and stable non-precious metal catalysts for the electrochemical oxygen reduction reaction (ORR) occurring on the fuel cell cathode. The most promising for anion exchange membrane fuel cell (AEMFC) cathodes are transition metal-containing nitrogen-doped carbon materials.[1] These are usually synthesized by high-temperature pyrolysis of carbon, nitrogen, and transition metal precursors.

Previously, we have used rapeseed press cake as the organic precursor, dicyandiamide (DCDA) as a nitrogen source and Fe and/or Co salts for preparing electrocatalysts via a simple one-step pyrolysis process.[2] The addition of magnesium acetate as a template precursor in the catalyst preparation process has noticeably improved the ORR activity of the materials. The resulting catalysts showed excellent ORR activity in 0.1 M KOH with the best material FeNCR-MgAc-3-1 surpassing commercial 20 wt% Pt/C (Figure 1). This increase in activity may be attributed to improved material morphology - according to nitrogen physisorption analysis, the best material had almost 30% higher specific surface area (SSA) and almost 50% more total pore volume than the untemplated material.

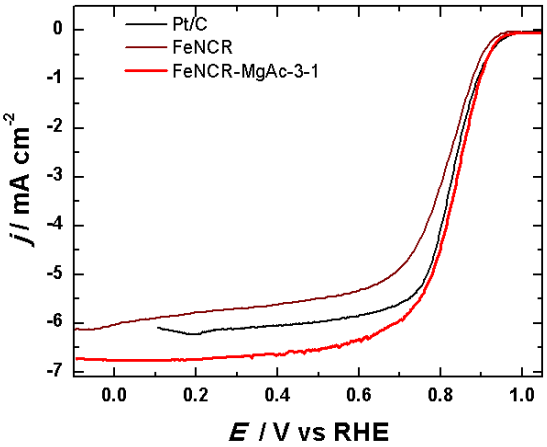

Figure 1. ORR polarization curves of different catalyst materials in O_2 saturated 0.1 M KOH at 1900 rpm. Loading: 200 μg/cm^2.

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References

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