

Highly Active and Durable Co-N-C Electrocatalysts Synthesized Using Exfoliated Carbon Nitride Nanosheets

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Pt-free electrocatalysts for oxygen reduction reaction (ORR) with high electrocatalytic activity/durability and low price are desirable for the future commercial applications of proton exchange membrane fuel cell (PEMFC) devices. However, the design and fabrication of such material systems remain a significant challenge. Here we report the preparation of Co-N-C nanocomposites synthesized by employing exfoliated graphitic carbon nitride layers functionalized with transitional metal ions. The synthesized products show highly porous and interconnected nanostructures. This electrocatalyst has displayed a very efficient ORR performance with an onset-potential (0.87 V) and half-wave-potential (0.80 V) close to that of commercial Pt and remarkable durability (18.8 mV shift after 7,000 cycles under 0.1 M KOH condition). The extraordinary ORR performance stems from strong synergistic effect originating from (i) highly exposed catalytically-active sites generated by introduction of exfoliation of g-C₃N₄ into nanosheets, (ii) hierarchical porous structure of the nanocomposite film, and (iii) electrically conductive network.