Electrocatalytic activity and stability of Pt @ NNMCs for oxygen reduction reaction in acid and alkaline electrolytes

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Avoiding fossil fuel dependency as a limited energy supply and source of numerous toxic gas emissions do not only result in steadily environmental pollution and global warming but also directly endanger human health, the replacement of conventional internal combustion engine by more environmental friendly and highly efficient automobile engines sounds imperative.[1]One promising alternative for combustion engines is polymer electrolyte fuel cells (PEMFCs) using pure hydrogen gas or hydrogen-rich fuels from renewable sources.

Although Pt and Pt alloys supported on high surface area carbon are currently used in both cathode and anode of these FCs, but the natural scarcity and increasing price of Pt motivate researchers to concentrate on designing and manufacturing non noble metal catalysts performing the electrocatalysis of oxygen reduction. Although in recent years the activity of the NNMCs reach the Pt activity but they still suffer from low stability which is the main obstacle of their commercializing.[2,3]

In this work, we report a hybrid electrocatalysts composed of Pt nanoparticles loaded on NNMCs as the support with the aim of reducing Pt loading by replacing NNMC actives sites for performing oxygen reduction reaction. In RDE measurements, we could successfully reach the activity of the commercial benchmark of Pt 20%wt by Pt 10%wt loaded on Fe/PANI/ketjen both in acid and alkaline electrolytes. Additionally the potential cycling stability test of the catalyst drastically showed an increase in comparison to both pt/vulcan and Fe/PANI/ketjen catalysts which can be interpreted as the interaction of Pt with nitrogen moieties created on the catalyst surface, although the nature of this interaction is not fully understood. TEM images showed the homogeneous distribution of nanoparticles on the catalyst surface. XRD characterization also showed a narrow size distribution of the Pt nanoparticle synthesized on the NNMCs ranging from 2-4 nm.

These results showed that Pt@NNMCs can be a promising class of catalysts to replace pt supported on carbon in short term.

References

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