HIGH-PERFORMANCE PLATINUM-FREE OXYGEN REDUCTION CATALYSTS WITH OUTSTANDING POROSITY USING HYDROXYAPATITE AS A HARD TEMPLATE

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Using green hydrogen as an alternative fuel to generate power with fuel cells has gained substantial attention in recent years. However, its adoption has been hindered by the high cost of platinum, which is a critical component in the catalysts used in low-temperature fuel cells [1]. One pathway to circumvent this issue is to construct fuel cells that operate in alkaline conditions presenting an opportunity to use platinum-free catalysts based on non-critical raw materials such as iron, nitrogen, and carbon. The performance of these novel catalysts depends on many important parameters, one of which is porosity [2].

We propose using an acicular hydroxyapatite (HA) nanopowder as a hard template to produce Fe-N-C catalyst materials with outstanding porosity. HA can be leached from the material with safer acids compared to the extremely toxic hydrofluoric acid needed to leach the silica spheres commonly used to obtain sufficient porosity in commercial Fe-N-C catalysts [3]. Using HA as a hard template generated a carbon material with abundant pores and cavities ranging from 10 to 3000 nm. The proposed synthesis method was validated in rotating ring disk electrode experiments where high activity and selectivity towards the oxygen reduction reaction were obtained. Finally, a peak power density value of 1.06 W cm^{-2} was obtained in an anion exchange membrane fuel cell test, ranking among the best results for platinum-free catalysts.

References

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