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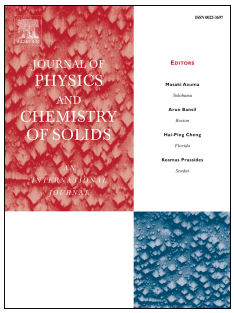

Bio-derived carbon as an efficient supporting electrocatalyst for the oxygen reduction reaction

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Bio-derived carbon as an efficient supporting electrocatalyst for the oxygen reduction reaction

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Abstract

Many valuable materials go unnoticed in waste. Thus, we investigated the use of carbon derived from jackfruit seed as a support for catalysts, where it was combined with nitrogen and other electroactive functional groups. An electrically conductive network ornamented with Pt nanoparticles (3–4 nm) was obtained as an efficient electrocatalyst for the oxygen reduction reaction. A feasible catalytically active and comparatively cheap electrocatalyst was constructed with an electrocatalytic surface area (S_{ESA}) of 68.5 m^2 g^{-1}. The active participation of Pt nanoparticles (NPs) in the cleavage of O-O bonds on the exposed surface area of the carbon was facilitated by the high specific surface area ($i_{SA, Pt}$: 59.7 mA cm^{-2}) and mass activity ($i_{ma, Pt}$: 40.9 mA mg^{-1}). In particular, polarization yielded a diffusion-limiting current region under 0.58 V vs a reversible hydrogen electrode (RHE) and a mixed kinetic-diffusion current region between 0.58 V to 0.87 V vs RHE with a limiting current density of 5 mA cm^{-2}. In addition, the oxygen reduction reaction mainly proceeded via the $4e^-$ pathway with a kinetic current density of 43.4 mA cm^{-2} according to Koutecky–Levich plots. Durability testing after 5,000 cycles demonstrated the stability of the carbon support where it anchored the Pt NPs homogeneously over the surface active sites. Due to its excellent electrochemical performance, this value-added bio-derived carbon may provide an efficient catalyst support for fuel cell applications.

Keywords: durability test; electrocatalyst; electrochemical study; jackfruit seed; oxygen reduction reaction.