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Fluorine-decorated graphene nanoribbons for an anticorrosive polymer electrolyte membrane fuel cell

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Abstract

Pt-supported carbon material-based electrocatalysts are formidably suffering from carbon corrosion when H2O and O2 molecules are present at high voltages in polymer electrolyte membrane fuel cells (PEMFCs). In this study, we discovered that the edge site of a fluorine-doped graphene nanoribbon (F-GNR) was slightly adsorbed with H2O and was thermodynamically unfavorable with O atoms after defining the thermodynamically stable structure of the F-GNR from DFT calculations. Based on computational predictions, the physicochemical and electrochemical properties of F-GNRs with/without Pt nanoparticles derived from a modified Hummer's method and the polyol process were investigated as support materials for electrocatalysts and additives in the cathode of a PEMFC, respectively. The Pt/F-GNR showed the lowest degradation rate in carbon corrosion and was effective in the cathode as additives, resulting from the enhanced carbon corrosion durability owing to the improved structural stability and water management. Notably, the F-GNR with highly stable carbon corrosion contributed to achieving a more durable PEMFC for long-term operation.