Generalized Route to Fe-N/C Electrocatalysts with Preferentially Generated $Fe-N_x$ Active Sites for Efficient Oxygen Reduction Reaction

사영진[1], 우진우[2], 김민규[3], 김태영[4], 주상훈[2,1,†]

[1]울산과학기술원 화학과; [2]울산과학기술원 에너지및화학공학부; [3]포항가속기연구소; [4]한국에너지기술연구원

(shjoo@unist.ac.kr[†])

Iron-nitrogen on carbon (Fe-N/C) catalysts with $Fe-N_x$ active sites have emerged as promising non-precious metal catalysts (NPMCs) for oxygen reduction reaction (ORR) in energy conversion and storage devices. However, rational design of Fe-N/C catalysts with abundant $Fe-N_x$ species represents a challenge. In this talk, a general "silica-protective-layer-assisted" approach that enables the preferential generation of active $Fe-N_x$ sites while suppressing the formation of less active large Fe-based particles is presented. The resulting catalyst comprised of carbon nanotube wrapped with thin porphyrinic carbon layer (CNT/PC) showed high ORR activity and remarkable stability in alkaline media. Importantly, a CNT/PC-based cathode exhibited record high current and power densities in an alkaline anion exchange membrane fuel cell (AEMFC) among NPMC-based AEMFCs, and also showed excellent performances in acidic proton exchange membrane fuel cells. We further demonstrated the generality of this synthetic strategy to other carbon supports including reduced graphene oxides and carbon blacks.