Platinum alloy nanocatalyst with manipulated particle composition and morphology for improved ORR property

Zhenmeng Peng
The University of Akron, USA

Catalyst activity and durability are two confronted difficulties in the Oxygen Reduction Reaction (ORR) research for fuel cell applications. Pt remains the most effective element for ORR in acidic electrolyte for both reaction kinetics and durability considerations. Because of a high Pt price and its insufficient activity, extensive studies have been devoted to decreasing the Pt usage by searching new Pt nanostructures with improved ORR property. The discovery that single crystalline Pt$_3$Ni (111) can exhibit exceptionally high ORR activity points to a strategy for solving the problem by using octahedral Pt alloy nanoparticles. However there are two challenges remained with the octahedral Pt alloy nanocatalyst strategy: the developed wet synthetic methods have low scaling-up capacity and surface contamination issue and are thus not suitable for mass production of the shaped Pt alloy nanoparticles; currently researched octahedral Pt alloy nanoparticles have insufficient durability. We realize scalable and surfactant-free production of octahedral Pt alloy nanoparticle catalysts by developing a new impregnation method. The prepared octahedral Pt$_2$CuNi/C uniform alloy nanoparticle catalyst exhibited both excellent ORR mass activity of 2.35 A/mg Pt at 0.90 V vs. RHE and promising stability, with 81.3% and 68.1% retained activity after 4,000 and 10,000 cycles of durability test. The finding provides insights on factors determining the particle stability and offers guidance on development of highly active and durable ORR catalyst for real applications.

zpeng@uakron.edu