TaOx-capped Pt nanoparticles as efficient catalysts for polymer electrolyte fuel cells

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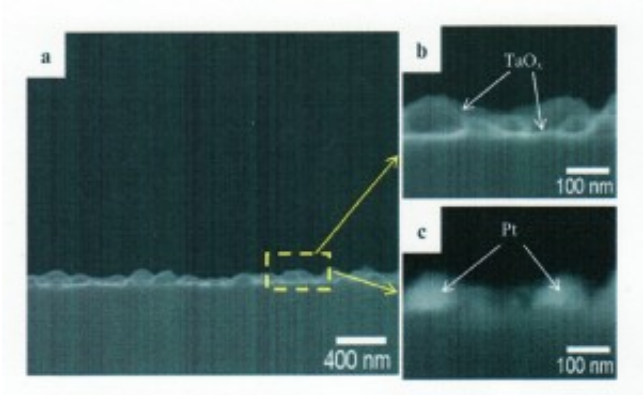


Cross sectional images of SEM (a, b) and BSEM (c) of Pt/TaO_x catalyst on GC electrode

One of the challenges for the commercialization of polymer electrolyte fuel cells (PEFCs) is the development of new cathode catalysts for the oxygen reduction reaction (ORR) that exhibit superior activity and durability than conventional platinum (Pt) catalysts (Pt/C).

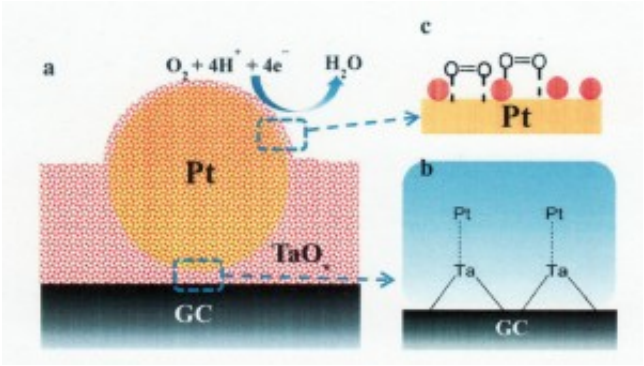
Here, Zaenal Awaludin, Takeo Ohsaka, and colleagues at Department of Electronic Chemistry report the development of TaO_x (tantalum oxide) nanoparticles-capped Pt nanoparticles (Pt/TaO_x) that possess a higher activity and durability than a Pt catalyst alone.

The Pt/TaOx catalyst has a unique structure comprising of a TaOx-

capped Pt nanoparticles. The Pt/TaOx structures were prepared by electrodeposition of TaOx nanoparticles followed by Pt nanoparticles on glassy carbon (GC) electrodes.

The electrochemically active surface area (ECAS) of the TaO_x-capped Pt nanoparticles catalyst is about one-fourth of that of the Pt/C , but its ORR activity is almost comparable to that of the Pt/C and its durability is about 8 times higher compared with the Pt/C.

The unique assembly of the TaO_x-capped Pt nanoparticles catalyst in which the Pt nanoparticles are dimensionally stabilized by the porous TaO_x framework could prevent the Pt nanoparticles from aggregation and dissolution. The enhanced ORR activity is ascribed to factors that include a favorable adsorption of O_2 molecules for 4e-ORR as a result of a spillover effect which may alleviate the poisoning effect of OHad species on the Pt surface; lowering the local pH in the vicinity of Pt nanoparticles; and electronic interaction between Pt nanoparticles and TaO_x.



Schematic illustrations of (a) TaO_x-capped Pt nanoparticle within a TaO_x framework, (b) bonding formation of Ta with GC and Pt, and (c) O_2 adsorption on Pt-TaO_x surface

The TaO_x-capped Pt nanoparticles have a dimensionally stable structure and expected to be a promising electrocatalyst for ORR in PEFCs.

More information: "TaO_x-capped Pt nanoparticles as active and durable electrocatalysts for oxygen reduction." Zaenal Awaludin, et al. *J. Mater. Chem. A*, 2013,1, 14754-14765. DOI: 10.1039/C3TA12492D

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