OXYGEN REDUCTION REACTION

Hydrophobic help

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Platinum-based materials are currently the most effective catalysts for the cathodic oxygen reduction reaction (ORR) in polymer electrolyte fuel cells. Although a variety of approaches, including alloying and nanostructuring, have been employed to improve the activity of platinum catalysts, additional strategies to boost their performance could open up pathways to further decrease the amount of platinum required at the electrode. Now, Masashi Nakamura and colleagues in Japan demonstrate an alternative means to modify the ORR activity of single-crystal platinum electrodes by including tetraalkylammonium cations in the reaction solution, which can increase activity by a factor of eight.

The researchers investigate a series of tetraalkylammonium cations with a range of alkyl chain lengths, from one carbon atom to six carbon atoms (tetra-*n*-hexylammonium). They find that longer carbon chains lead to enhanced rates of ORR over Pt(111) surfaces, which they attribute to their greater hydrophobicity. Specifically, the hydrophobicity of the tetraalkylammonium cations effects the arrangement of the water molecules that surround them in the hydration shell; which in turn impacts how the water molecules in the reaction solution interact with species adsorbed to the surface of the catalyst. The researchers suggest that more hydrophobic tetraalkylammonium cations can thus disrupt and destabilize surface-adsorbed OH groups, which would otherwise poison the Pt(111) surface, increasing the activity of the catalyst.

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