ECSTM Studies of the Electrocatalyst Stability for the AAEM Fuel Cell

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Abstract

Alkaline fuel cells (AFC) have come to the forefront of fuel cell research due to the friendlier environment they provide to the cell's components in comparison to acid-based Proton Exchange Membrane (PEM) fuel cells. The AFC shows real world application of 60% efficiency, but suffers from long term degradation due to the formation of carbonate precipitates formed from carbon dioxide. A solid-state form of the AFC, the alkaline anion exchange membrane (AAEM) fuel cell, is under development to overcome the degradation, due to the usage of liquid potassium hydroxide (KOH) or sodium hydroxide (NaOH) electrolytes in the AFC. Also, the AFC are known to have a higher rate of contamination and therefore need higher purity fuel than their acidic counterparts. This problem is eliminated by the AAEM fuel cell.

The cathode, which consists of the catalyst, ionomer and current supports in the AAEM fuel cell or the AFC, is the key component that determines the cell's performance and stability. The material found to work best for the AAEM fuel cell is platinum (Pt). The issue with Pt as a catalyst material for these fuel cells is that is it very cost prohibitive for mass production. Therefore, other metals are being investigated to find a material with less cost, but perform as well as the Pt in AAEM fuel cells.

Several theories have been proposed as to the cause of cathode degradation. It was found that an increase in current density, temperature and ligand (OH^-) concentration accelerated corrosion of catalysts and carbon supports. Studies have been done on the catalyst material of Pt, as well as the highly oriented pytolytic graphite (HOPG). HOPG is a carbon-based material that Pt is deposited upon. So far, most of these studies were done in acid media.

The objective of this work is to develop an *in situ* electrochemical scanning tunneling microcopy (ECSTM) method for characterizing stability of nano-Pt and HOPG substrate under operation conditions of an AFC.

Future research will characterize the stability of other metal nanostructure in an attempt to find cheaper and effective alternatives to Platinum.