Graphene Oxide and Reduced Graphene Oxide Coated Nafion Membranes for Enhanced Performance in Hydrogen Fuel Cells

Akker, Cameron

This experiment tested the effect of graphene oxide (GO) and reduced graphene oxide (RGO) on polymer electrolyte membrane (PEM) fuel cell power efficiency when the two substances were coated on the Nafion membrane separating the electrodes of the cell. GO and RGO exhibit unique thermal, electrical, and tensile properties comparable to metal alloys and displayed a catalytic effect on contaminant carbon monoxide conversion within the fuel cell. The Nafion membranes were coated using a Langmuir-Blodgett trough with a water subphase. GO and RGO solution was added to the trough during the process of barrier compression at staggered intervals in order to maintain sufficient surface pressures. A clean isotherm curve that included pressures up to 17mN/m was obtained when the GO/RGO solution was added at a rate of 1mL every 4 minutes. When the coated membranes were tested in a fuel cells with a 40ccm hydrogen gas flow rate, every coated membrane showed an increase in power over the uncoated control. The RGO membrane coated at 3mN/m increased the maximum power of the fuel cell by 84%. GO was also effective, producing a 59% power increase over the uncoated membrane. The increase in power from these coated membranes can be attributed to the proton conductivity of GO and RGO as well as their catalytic effect against carbon monoxide contamination. By providing an alternate mechanism for CO reaction to CO2, GO and RGO increase fuel cell power output by speeding up the rate determining step of water formation at the cathode.

Awards Won:

Third Award of $1,000