Design and Simulation of Sensors to Detect Methanol

C. K. Subramaniam[1], Muthuraja[1]

[1]School of Electronics Engineering, VIT University, Vellore, Tamil Nadu, India

Abstract

The Direct Methanol Fuel Cell (DMFC) working is dependent on the concentration of methanol in water before it is introduced in the anode. DMFC has a high energy density when generating electrical power from fuel, and is an attractive power source for portable devices. A fundamental limitation in DMFC technology is methanol crossover. In this process methanol diffuses from the anode through the electrolyte to the cathode, where it reacts directly with the oxygen and produces no electrical current from the cell. Poisoning of the cathode catalysts is also another problem.
In order to regulate methanol concentration, since the methanol crossover rate is roughly proportional to the methanol concentration at the anode, it is necessary to accurately sense the concentration of methanol in solution. Various types of sensors may be used to measure the concentration of methanol in an aqueous solution. Capacitance devices, which measure the change in the dielectric constant of the methanol solution, can be used as methanol sensors. However, the difference in dielectric constants for a methanol-water system is small leading to less accurate values.
A sensing device, in wide range of methanol concentrations, up to about, 10 mol/L, would be very helpful for DMFC optimized operation. A passive mode design, of about 1/10th of a cm area, using a single parameter function, will be designed. The design and simulation would involve optimization of various parameters like the area of the working electrodes and counter electrodes, separation distance and overlap length between working electrodes and counter electrodes using COMSOL Multiphysics. The present work would be implemented using Batteries and Fuel cell physics interface in COMSOL Multiphysics. This output would be implemented in a real time design. The paper will present the optimized design parameters of the sensing device.