University of Hawai`i at Mānoa
Hawai`i Natural Energy Institute
School of Ocean & Earth Science & Technology

# The Biocarbon Fuel Cell III

Thermodynamics permits the carbon fuel cell, which is a battery that generates electrical power by the electrochemical combustion of its carbon fuel, to realize a theoretical efficiency of 100%. In a recent paper [*Ind. Eng. Chem. Res.* **2007,** *46,* 734 – 744] we reported promising results obtained from a moderate-temperature, aqueous-alkaline biocarbon fuel cell. In view of the fact that aqueous-alkaline hydrogen fuel cells have been used to power an Austin car and a commercial Black Cab in London, these recent results suggest that aqueous-alkaline carbon fuel cells could become an alternative to the internal combustion engine for vehicular transportation. Usually the practicality of an aqueous-alkaline carbon fuel cell is discounted because the carbon dioxide product of carbon oxidation reacts with and consumes hydroxyl ions in the aqueous-alkaline electrolyte; thereby forming carbonate ions. As a result of this reaction, the performance of an aqueous-alkaline carbon fuel cell is expected to deteriorate over time. Contrary to this expectation, in this presentation I show that the carbonate ion can be as effective as the hydroxyl ion as a charge carrier when the temperature of the cell reaches 300 °C. Thermodynamic estimates of the Gibbs free energy of formation $\Delta_f G°$ of the carbonate ion indicate that the change in Gibbs free energy of the relevant carbon oxidation reaction with carbonate ion equals that of carbon oxidation by hydroxyl ion at 300 °C. These findings should encourage experimental measurements of $\Delta_f G°$ for the carbonate ion in hydrothermal solutions at temperatures near 300 °C.

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