The Effects of Temperature on Hydrogen Fuel Cell Efficiency

Therezo, Vitor (School: Escola Americana de Campinas)

Modern society realizes the great need for environmentally friendly energy sources. Hydrogen was long known as a clean energy option but it is hardly found in nature as a pure substance. The most advanced process to obtain it is by the electrolysis of water using Proton Exchange Membrane (PEM) cells. However, the overall process of using Hydrogen as a source of power is inefficient, as more energy is spent to separate H2 than it is generated back by it. This project aims to find a more efficient and economically viable way of using Hydrogen by investigating if there is an optimal temperature that increases the ratio between energy consumption and production in the H2 cycle. That was done by measuring this ratio at six temperatures ranging from 0° to 100° Celsius. Multimeters measured voltage and current over time during the production and subsequent use of 16ml of Hydrogen in a PEM Cell. All different temperatures showed similar efficiencies, varying from 30 to 40 percent. Although the ratios were similar, at high temperatures, they were the result of lower amounts of energy produced and consumed; meanwhile, low temperatures generated the same ratios, resulting from higher amounts of energy produced and consumed. Surprisingly, there was not one optimal temperature for both processes. However, a combination of high and low temperatures (each one for each process) is the solution for maximum efficiency. By doing hydrolysis at 100°C and power generation at 0°C, the efficiency of the H2 cycle can be boosted to 65%.

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