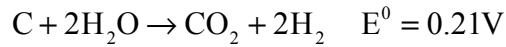


Ohio University  
 Department of Chemical Engineering  
 ChE-455/ChE-455: Analysis of Electrochemical Systems  
 Winter Quarter 2009

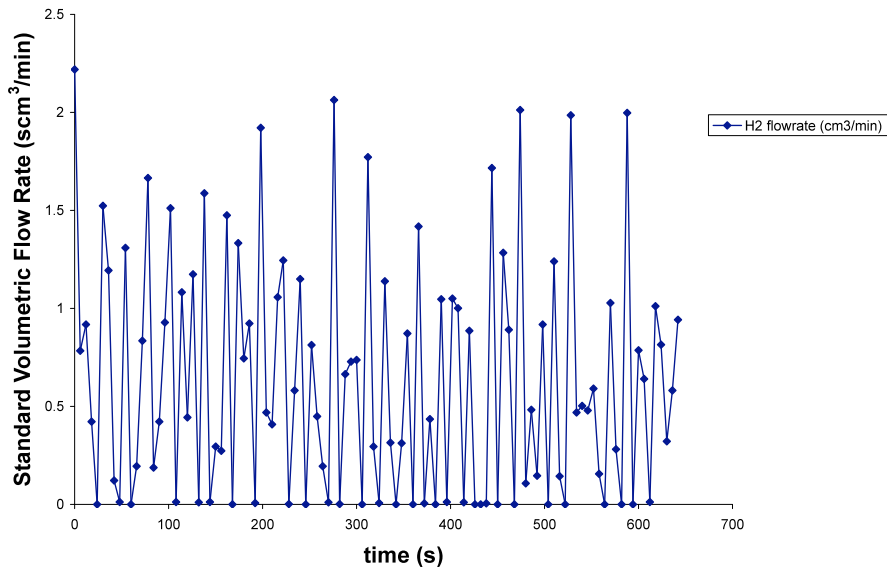
**Homework 2**

Due: January 22, 2009

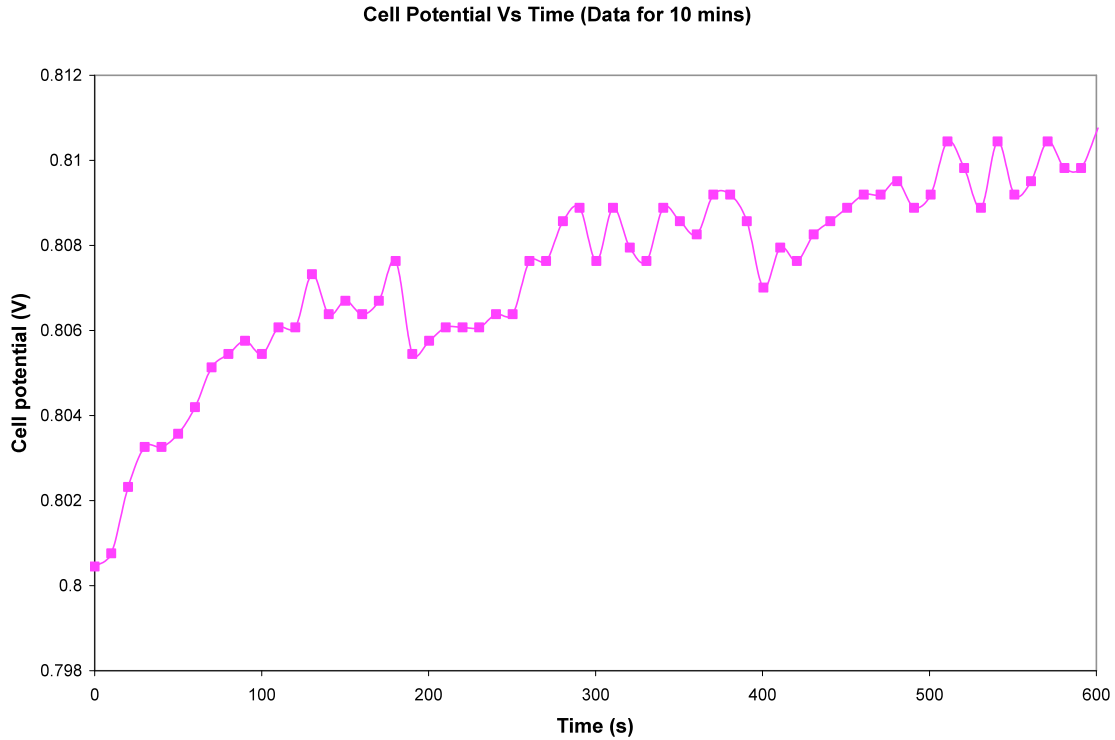
1. A proton exchange membrane uses hydrogen as fuel, while oxygen is reduced at the cathode in an acidic medium.
  - a. Calculate the standard potential of a PEM fuel cell operating with pure oxygen.
  - b. Calculate the open circuit potential of a PEM fuel cell operating with air.
  - c. What can you conclude from a thermodynamics standpoint from the comparison of calculations a and b?
2. According to Coughlin and Farooque the electrolysis of coal in acidic medium takes place according to the overall reaction:



- a. What is the cathodic reaction taking place on the cell?
- b. The standard hydrogen flow rate is given below as a function of time. Calculate the current efficiency. Explain your findings. The data was collected at a constant current of 100 mA.



- c. As coal is getting oxidized the voltage of the cell changes as given in the graph shown below (applied current 100 mA). Calculate the voltage efficiency



- d. What is the Power of the cell? Calculate the energy efficiency.
- e. Theoretically, what process consumes less energy the electrolysis of water or the electrolysis of coal? Justify your answers with calculations.

3. An electrochemical engineer is trying to decide if he should use a solution of 1M HCl or a solution of 1M H<sub>2</sub>SO<sub>4</sub> as the supporting electrolyte for the electrolysis of water at two different temperatures: 25 °C and 100 °C. Based on electrochemical principles recommend what supporting electrolyte is more convenient to use. Justify your answer with calculations.