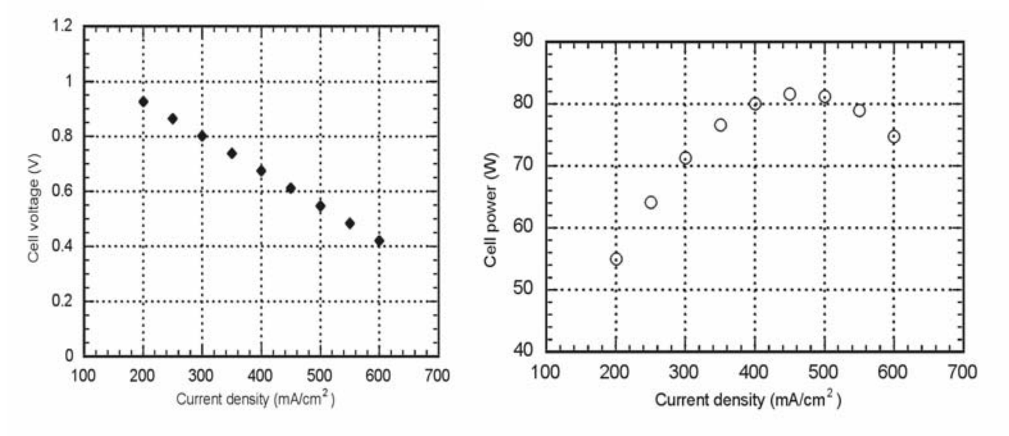
ME 1065 – HW #5
Due 11/10/08

1. GM has developed a fuel cell that is rated at 129 kW peak power. It occupies a volume of 14 x 82 x 50 cm^3 and has a mass of 82 kg. The 3.1 liter V6 engine of a Buick Century, on the other hand, has a peak power of 175 hp, an approximate volume of 30 x 24 x 18 in^3, and a weight of 1000 lb_f. In SI units, (a) calculate the specific energy density (kW/kg/volume) of each system, (b) calculate the power density (kW/volume) of each engine, and (c) briefly discuss the relative merits of the two systems (consider that you can buy a new V6 engine for around $2000).

2. The polarization curves for a solid oxide fuel cell are shown below. For a cell with an effective cell area of 300 cm^2, (a) determine the potential, current density, and power at the point of maximum power, and (b) at that same point, what is the thermal efficiency of the fuel cell?



3. Given a 2.0 MW fuel cell cycle operating on 700 lb_m/hr of methane, what is (a) the HHV thermal input of the methane gas (in MW), (b) the LHV thermal input (in MW), (c) the HHV electric efficiency, (d) the LHV electric efficiency, and (e) the HHV Heat Rate (the amount of heat required to produce 1 kW of electricity)? (Assume the higher and lower heating value of methane are 23,881 and 21,526 Btu/lb_m respectively.)

4. For the fuel cell described in the previous problem, what is (a) the combined heat and power efficiency assuming that cycle produces 2 tons/hr of 150 psia/400ºF steam? Assume a feedwater temperature of 60ºF, and use the HHV (rather than the LHV) electric efficiency or thermal input.