Department of Materials Science and Engineering
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AMSE206 Thermodynamics II

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Problem Set #5

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1. Fayalite, 2FeO·SiO2, is the only silicate compound formed by reaction of FeO with SiO2 at a total pressure of 1 atm, and the standard Gibbs free energy change for the reaction

$$2FeO(s) + SiO_2(s) = 2FeO\cdot SiO_2(s)$$

is -11,070 J at 1200 K. Calculate the EMF of the cell

$$Fe|SiO_2|2FeO\cdot SiO_2|CaO\text{-}ZrO_2|FeO|Fe$$

at 1200 K.

2. A waste liquor consists of a 0.5 molal solution of CaCl2 in water. Calculate the minimum work, per mole of CaCl2, required to separate the liquor into anhydrous CaCl2 and pure water at atmospheric temperature and pressure. The mean ionic activity coefficient of 0.5 molal CaCl2 is 0.448. The minimum work is that required when the separation is conducted reversibly, i.e., $w = -\Delta G$ for the process. 0.5 molal CaCl2 comprises 0.5 moles of CaCl2 and 1000 grams of H2O or 0.5 moles of CaCl2 and 1000/18 = 55.55 moles of water. Thus 1 mole of CaCl2 exists in 111.1 moles of water, and the mole fraction of water is 111.1/112.1 = 0.991.