Student Question

Where is a good place for me to get the ln(K) value for Si(s)+O2(g)-->SiO2(s)?

Answer

To find ΔG^o's for reactions in general, use the following data sources. I will use $Si_{(s)} + O_{2(g)} = SiO_{2(s)}$ as an example reaction.

1) Your thermo book has values of ΔG^o in the form A + BT for selected reactions.

2) JANAF Thermochemical Tables (available online by link on MET 320 web site, Google search, or SDSMT library) is a much more robust data source. JANAF gives ΔG^o's of formation so to get ΔG^o for the reaction

   $$Si_{(s)} + O_{2(g)} = SiO_{2(s)} \quad \Delta G^o_A$$

   one would take the Gibb's energies of formation of the products minus the Gibb's energies of formation of the reactants as shown below.

   $$\Delta G^o_A = \Delta G^o_{form,SiO2\ (S)} - \Delta G^o_{form,\ Si\ (s)} - \Delta G^o_{form,O2\ (g)}$$

   Of course, $\Delta G^o_{form,O2\ (g)} = 0$ and so is $\Delta G^o_{form,\ Si\ (s)}$ up to the melting point of Si (elements in their most stable form).

   I believe we were using a different standard state for Si than you have in the above reaction; namely,

   $$Si_{(l)} + O_{2(g)} = SiO_{2(s)} \quad \Delta G^o_B$$

   If you are above the melting point of Si and the standard state of Si is to be a liquid, then

   $$\Delta G^o = \Delta G^o_{form,SiO2\ (S)}$$

   Is still true since the Gibb's energies of formation of the elements oxygen and silicon, being in their most stable form, are zero as follows from the definition of "formation". If one is above the melting point of Si but the standard state of Si is to be pure solid Si, then $\Delta G^o_{form,\ Si\ (s)}$ must be subtracted from $\Delta G^o_{form,SiO2\ (S)}$ to get ΔG^o.

3) You may make an equation for either of the above reactions by finding the slope and intercept of the line (perhaps extrapolated) on the Ellingham Diagram corresponding to the states of interest.

4) You may use TAB in ThermoCalc after retrieving the data for Si and O from database SSUB3. TAB will require you enter the reaction of interest. You may fix the standard states using "<- ->"'s.

5) Any number of extractive books have ΔG^o data. I like the collection in the Making Shaping and Treating of Steel. See pages 388-391 in edition 10 and pages 20-21 in edition 11 (Steelmaking

volume). The Ironmaking volume (edition 11) also has the same data; however, the 10th edition has more data than the 11th edition.