

**South Dakota School of Mines and Technology**  
**Department of Materials and Metallurgical Engineering**

Met 426/526

Homework

1. Plot the activity of C in austenite relative to pure solid graphite as a function of both mole fraction and wt % C. (To do this in Excel, one must make the mole fraction and the wt % the vertical scale and activity the horizontal scale.)
2. Compute for each mole fraction for which activity data is tabulated in Hultgren, et al. the corresponding value of  $f_C$  and wt % C. Place the results in the table below.

**Selected Solution Values for C in Austenite at 1426 K**

$x_C$	wt % C	$a_C$	$\gamma_C$	$h_C$	$f_C$	$e^C_C$
0.00		0.000	4.894			
0.01		0.053	5.323			
0.02		0.116	5.800			
0.03		0.190	6.323			
0.04		0.276	6.911			
0.05		0.378	7.570			
		(±0.028)	(±0.570)			
0.06		0.499	8.309			
0.07		0.638	9.121			
0.08		0.805	10.064			
0.09*		1.000	11.111			

\*Phase boundary

3. Construct a plot of  $h_C$  vs. wt % C.
4. Why is  $f_C > 1$  when  $\gamma_C > 1$ ? [Normally, when  $\gamma_i > 1$ ,  $f_i < 1$ ; when  $\gamma_i < 1$ ,  $f_i > 1$  and when  $\gamma_i = 1$ ,  $f_i = 1$ .]
5. Estimate the value of the self-interaction coefficient of carbon.

**Selected Thermodynamic Values for C Component in  $\gamma$ -Fe at 1426 K**

$C = \underline{C}$  (in alloy)

$x_C$	$a_C$	$\gamma_C$	$G^M_C$	$G^{XS}_C$	$H^M_C$	$S^M_C$	$S^{XS}$
0.00	0.000	4.894		4500	10552		4.244
0.01	0.053	5.323	-8312	4738	10729	13.353	4.201
0.02	0.116	5.800	-6105	4981	10910	11.932	4.158
0.03	0.190	6.323	-4710	5226	11094	11.083	4.115
0.04	0.276	6.911	-3643	5478	11282	10.466	4.070
0.05	0.378	7.570	-2753	5736	11474	9.977	4.024
	(±0.028)	(±0.570)	(±200)	(±200)	(±500)	(±0.380)	(±0.380)
0.06	0.499	8.309	-1973	6000	11671	9.568	3.977
0.07	0.638	9.121	-1267	6268	11871	9.213	3.929
0.08	0.805	10.064	-614	6543	12076	8.899	3.880
0.09*	1.000	11.111	0	6823	12285	8.615	3.830

\*Phase boundary

Source - Ralph Hultgren, Pramod Desai, Donald Hawkins, Molly Gleiser, and Kenneth Kelley:  
**Selected Values of Thermodynamic Properties of Binary Alloys**, ASM, Metal Park, OH, 1973.