Thermodynamic Calculations of FeC under Magnetic Field

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ABSTRACT

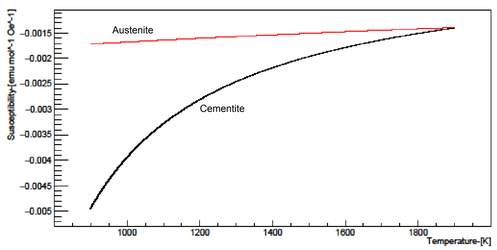
This Project calculated the behavior of the FeC system under the effects of 120, 200 and 500 kOe magnetic fields. The phase diagram of FeC were generated for the previously mentioned magnetic fields using the ThermoCalc software. The lower portion of the diagram was pushed up while the lower portion moved down compressing the phase diagram of FeC.

Background

For chemical systems at constant temperature and pressure, the preferred arrangement, phase, will minimize the Gibbs Free Energy, G, where

$$G = H - TS$$

H being Enthalpy, T being Temperature, and S being Entropy. Equilibrium for a material can then be found by simply determining the



the Gibbs energy has

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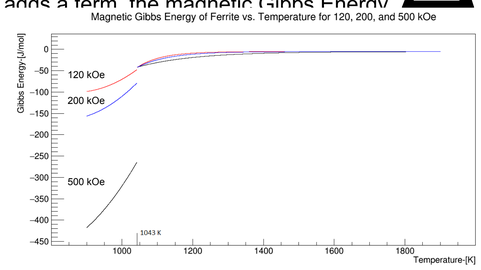
field. The magnetic field adds a term, the magnetic Gibbs Energy $\Delta G\downarrow m$,



$G\downarrow t$,

$G\downarrow t = G\downarrow 0 + \Delta G\downarrow m$

Phase Diagrams

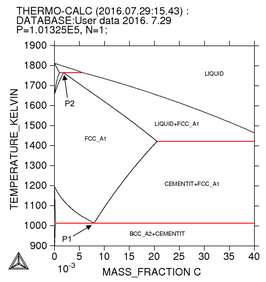


Figure 3: The Phase diagram of FeC at STP without any external magnetic field. For reference FCC is Austenite and BCC is Ferrite.

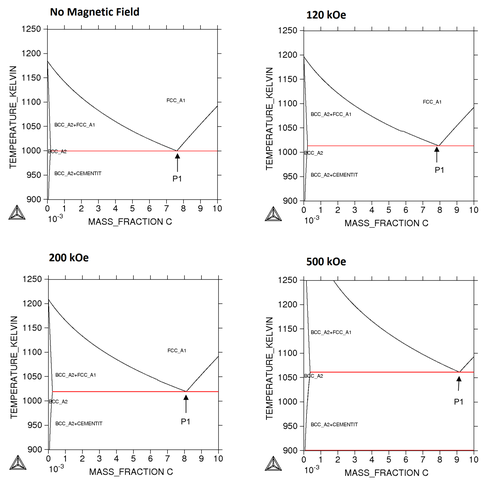


Figure 4: Blowups around the lower eutectic point, labeled P1, showing the movement of that point with increasing magnetic field.

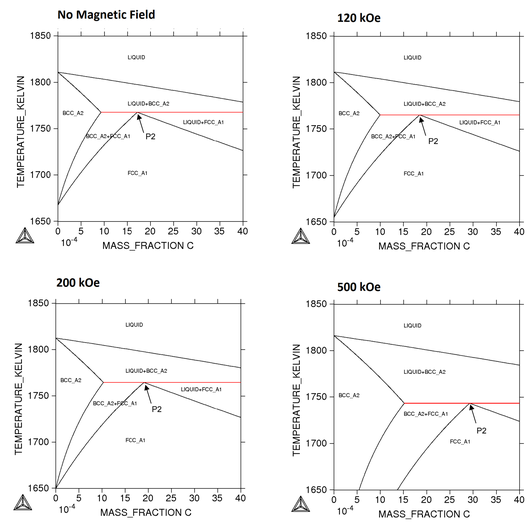


Figure 5: Same as Fig. 2 for the upper eutectic point, P2.

Results

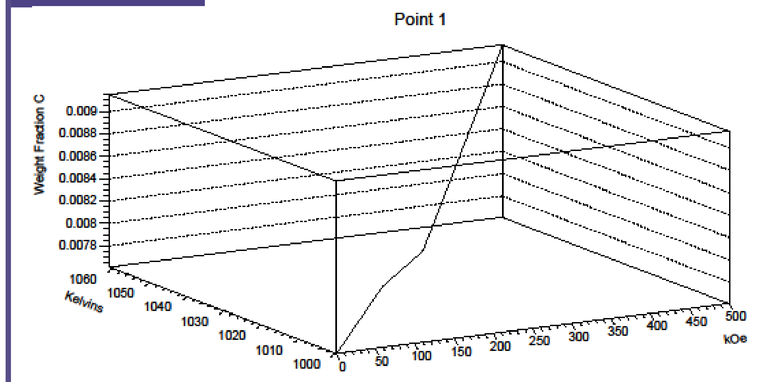


Figure 6: Graph of the location of P1 in the previous diagrams vs. magnetic field in kOe.

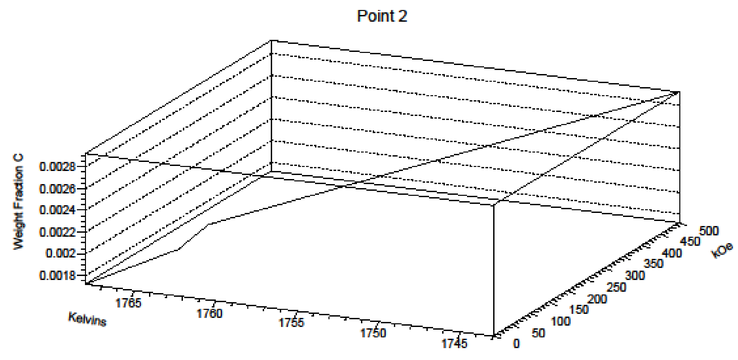


Figure 7: Graph of the location of P2 in the previous diagrams vs. magnetic field in kOe.

In conclusion, two eutectic points of the FeC diagram, P1 and P2, were tracked. Increasing magnetic field shiftd P1 up and P2 down compressing the center Austenite region of the FeC diagram.

Thanks

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Note: To preserve the upward trend of the data from the above paper, which was taken to be correct, the signs of the susceptibilities for Cementite and Austenite and the signs of the Magnetic Gibbs Energy functions were reversed.