Materials Science & Engineering Seminar Series

Carnegie Mellon University
Materials Science & Engineering

presents

Magnetic Transformations and Phase Diagrams

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ABSTRACT:
Phase diagrams are an integral part of the materials scientist's tool box for the manipulation and control of materials. Many of the published phase diagrams are based on first-order phase transformations, that is they utilize the Gibbs equilibrium phase rule to assure that they are presented in a consistent way. However, regions of the diagrams that contain magnetic transformations usually do not conform to the Gibbs phase rule. In this presentation various aspects of magnetic transformations will be introduced, including their thermodynamics (intensive variables, stability etc.), symmetry and mechanisms of transformation. Phase diagrams of single component systems (e. g. magnetization vs. temperature) will first be introduced and the role of magnetism on their thermodynamics will be presented. The important ferromagnetic Curie temperature will be defined. Binary phase diagrams will be discussed and the results of phase equilibria of the intersection of the Curie temperature lines will be examined. The role of the interplay between magnetic transformations and other non-first order phase transformations will also be discussed as will the use of applied magnetic fields to influence the equilibrium of first order phase boundaries in Fe based alloys. The goal of the talk (which is based on the 2017 Edward DeMille Campbell Memorial Lecture of ASM International) is to present the case that equilibrium phase diagrams that include higher order phase transformations should include their specific aspects in the representation of thermodynamic equilibrium.

BIOGRAPHY:
David E. Laughlin is the ALCOA Professor of Physical Metallurgy in the Department of Materials Science and Engineering at Carnegie Mellon University, where he has taught since 1974. He also holds a courtesy appointment in the Electrical and Computer Engineering Department at CMU. David is a graduate of Drexel University (BS in Metallurgical Engineering, 1969) and Massachusetts Institute of Technology, Ph.D. in Metallurgy, 1973). He was the Principal Editor of the *Metallurgical and Materials Transactions* family of journals of ASM International and TMS from 1987 to 2016. He has taught courses on physical metallurgy, electron microscopy, diffraction techniques, thermodynamics, crystallography, magnetic materials, phase transformations, and ferroic materials. He has more than 400 technical publications and is the editor (with Hiro Hono) of the recent edition of the three volume *Physical Metallurgy* (Elsevier). He also is the author (with David Gaskel), of the 6th edition of *Introduction to the Thermodynamics of Materials*. He is an Honorary member of the AIME and is a Fellow of ASM and TMS.

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