APh/MS 105 States of Matter

Instructor

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Content

After a general overview of phase transitions, the statistical mechanics of atom arrangements on a crystal lattice is developed. The approach uses a minimum amount of information about atom interactions and atomic degrees of freedom, and uses statistical mechanics to derive the basic behaviors of chemical unmixing and ordering transitions. This approach, with extensions, is used to illustrate key concepts of equilibrium phase diagrams, and is extended to explain some kinetic processes.

Effects of pressure, combined with temperature, are explained with a few concepts of chemical bonding. Further developments of the mechanisms of phase transitions are used to explain spinodal decomposition and criteria for second-order phase transitions. Some complexities of high temperature thermodynamics are presented.

Prerequisites include familiarity with basic statistical mechanics, including the use of the partition function to obtain thermodynamic quantities. Familiarity with some concepts from solid-state physics would be helpful, but many of the important concepts are developed as needed.

Text

B. Fultz, The Materials Physics of Phase Transitions, (2011). Acrobat pdf file.

Other Books

1. J. W. Christian The Theory of Transformations in Metals and Alloys, Pergamon (1981).
2. A. G. Khachaturyan, Progress in Materials Science, **22**, 1-150 (1978).

Grading

Homework (do not look at old assignments, late problem sets will receive 1/3 credit, students may discuss problem solutions verbally, but may not show each other any written work).

Zero Exams.