

Material Science

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Chapter 6. Phase Diagrams

Many of the engineering materials possess mixtures of phases, e.g. steel, paints, and composites. The mixture of two or more phases may permit interaction between different phases, and results in properties usually are different from the properties of individual phases. Different components can be combined into a single material by means of solutions or mixtures. *A solution (liquid or solid) is phase with more than one component; a mixture is a material with more than one phase.* Solute does not change the structural pattern of the solvent, and the composition of any solution can be varied. In mixtures, there are different phases; each with its own atomic arrangement. It is possible to have a mixture of two different solutions!

A pure substance, under equilibrium conditions, may exist as either of a phase namely vapor, liquid or solid, depending upon the conditions of temperature and pressure. A *phase* can be defined as a homogeneous portion of a system that has uniform physical and chemical characteristics i.e. it is a physically distinct from other phases, chemically homogeneous and mechanically separable portion of a system. In other words, a phase is a structurally homogeneous portion of matter. When two phases are present in a system, it is not necessary that there be a difference in both physical and chemical properties; a disparity in one or the other set of properties is sufficient.

There is only one vapor phase no matter how many constituents make it up. For pure substance there is only one liquid phase, however there may be more than one solid phase because of differences in crystal structure. A liquid solution is also a single phase, even as a liquid mixture (e.g. oil and water) forms two phases as there is no mixing at the molecular level. In the solid state, different chemical compositions and/or crystal structures are possible so a solid may consist of several phases. For the same composition, different crystal structures represent different phases. A solid solution has atoms mixed at atomic level thus it represents a single phase. A single-phase system is termed as homogeneous, and systems composed of two or more phases are termed as mixtures or heterogeneous. Most of the alloy systems and composites are heterogeneous.

It is important to understand the existence of phases under various practical conditions which may dictate the microstructure of an alloy, thus the mechanical properties and

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Fundamentals of Materials Engineering- A Basic Guide Shashanka Rajendrachari, Orhan Uzun, 2021-02-22 Fundamentals of Materials Engineering A Basic Guide is a helpful textbook for readers learning the basics of materials science This book covers important topics and fundamental concepts of materials engineering including crystal structure imperfections mechanical properties of materials polymers powder metallurgy corrosion and composites The authors have explained the concepts in an effective way and by using simple language for the benefit of a broad range of readers This book is also beneficial to the students in engineering courses at B Sc M Sc and M Tech levels *Materials Engineering* Dheerendra Kumar Dwivedi, 2025-06-01 **New Age Education Models** Dr. P. R. Muthuswamy, 2022-06-13 Rethinking Redesigning and Restructuring of higher education is the need of the hour This book intends to enlighten its readers about the 21st century education models for 21st century learners Such models would include skill oriented and technology based teaching and learning This book suggests various routes for student entrepreneurs to access resources throughout their college life to ultimately achieve their goals It also talks about the effectiveness of e learning tools in education emerging teaching techniques and methodologies by understanding the education models of different countries and benchmarking the best practices The book also highlights the importance and advantage of open source learning mobile learning and the role of creativity and its relevance with technology **Manufacturing Processes** Dheerendra Kumar Dwivedi, 2025-06-01

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