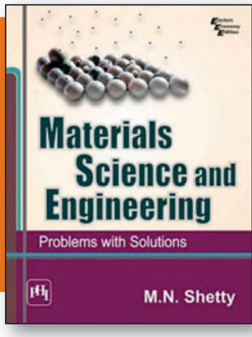


Materials Science and Engineering: Problems with Solutions

M.N. Shetty

PHI Learning, 2016
516 pages, $9.00
ISBN 978-81-203-5109-7

This book presents the solutions of problems and exercises covering a broad range of topics in materials science. It deals with electronic behavior in solids, the nature of bonding, and the corresponding structural, electric, magnetic, and thermal properties of materials. It gives a short introduction to all of these areas and is targeted toward undergraduate students, and possibly teachers from engineering areas, to be used as a backup book with examples that may be used along the entire course. The book is composed of five main chapters. The solution to each problem is performed with each step thoroughly justified, allowing the reader to easily follow the resolution. It is a large compilation of several years of teaching activities.

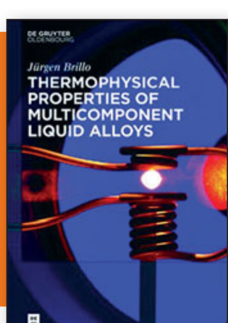
The book has more than 300 solved problems with a huge number of schemes and diagrams. Introductory concepts are given at the beginning of each chapter and during the resolution, and are always based on fundamental concepts taken from referenced sources on each specific topic. The first chapter is the longest one, nearly 190 pages and 90 problems, and presents a short introduction to wave mechanics and to the electronic behavior of materials. The second chapter has 160 pages and 120 problems related to chemical bonding and structural properties of materials. The third chapter focuses on both thermal and electrical properties of materials, although the main focus is on thermal characteristics of materials. This chapter has 84 pages and 28 problems. The fourth chapter is mainly dedicated to magnetic properties and has 36 pages and 14 problems. It does not give an exhaustive explanation, but covers the basics of magnetism. The last chapter has only 17 pages and nine problems and is mainly devoted to dielectrics and a specific ferroelectric material: $BaTiO_3$.

The organization of the book seems to be a bit unbalanced with two very long first chapters and ending with two much shorter ones. Also, the subdivision of topics makes it difficult to clearly identify the location of a specific theme in the book, such as electrical properties of materials. An equilibrium could have been reached by merging some details in a common chapter devoted to electrical properties of materials, gathering the Hall effect and electric properties of semiconductors from the first chapter along with the electrical conductivity from the second chapter and the dielectric and ferroelectric materials from the last chapter.

The book presents pictures and schematics along with the text that are very helpful. They are all diagrams and schematics in black and white and allow for clear reading.

The book has only 40 references, and they are not referenced in the body of the text, making it difficult to know where to get more insight or information on any specific topic. It is not clear if the problems are the author's own ones or if they were adapted from other sources. If the latter, then source references should have been explicitly mentioned. References are from older books and are not up to date (the most recent is from 2000). Aside from this, it is an excellent resource for students and teachers in materials science and engineering.

Reviewer: ***Joana Vaz Pinto*** *of the Universidade Nova de Lisboa, Portugal.*



Thermophysical Properties of Multicomponent Liquid Alloys

Jürgen Brillo

De Gruyter Oldenbourg, 2016
254 pages, $140.00 (e-book $140.00)
ISBN 978-3-11-046684-3

This is a small and very interesting book on thermophysical properties of liquid metals and their alloys. The author draws from his extensive experience on measuring properties of liquid metals to propose—and many times to develop—relationships between the thermodynamic properties and the density (molar volume), surface tension, and viscosity of pure liquid metals and some of their alloys. His approach is based on the well-established subregular solution model, which assumes that the excess thermodynamic properties of the alloys may be a function of temperature and composition. The thermodynamic model is semiempirical but has a large amount of assessed data from different research groups up to 2014, so it provides a robust approach to explain the liquid properties.

The book is structured with eight chapters and two appendices. The first chapter outlines the four questions that are answered within the book and provides the basis to use the experimental data to design new metallic alloys. Brillo aims to (1) find a general rule for the mixing behavior, (2) establish relationships between the excess thermophysical properties and thermodynamics, (3) correlate thermophysical properties of

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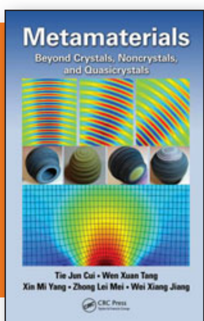
multicomponent liquid alloys with their constituent subsystems, and (4) identify inter-property relationships (surface tension, viscosity, and diffusion viscosity) for specific cases. The second chapter describes the experimental procedures applied to liquid alloys and their limitations, with an emphasis on levitation methods. The following three chapters discuss the density, surface tension, and viscosity following the same pattern: theory, experimental data for pure metals, their binary liquids, and, if available, their ternary liquids. The end of each chapter discusses Brillo's four questions and summarizes them.

The last three chapters cover the inter-property relations of liquid alloys, the solid–liquid and liquid–liquid interfacial energies of specific systems, and the thermophysical properties of some liquid Ga-Mn-Ni alloys (which provide magnetic shape-memory alloys), and present an overall discussion and conclusion. The two appendices present all of the experimental data on liquid alloys determined by Brillo's research group. Brillo did not provide a general rule for prediction of excess volumes or other thermophysical properties of the evaluated liquid pure metal and some of their binary and ternary alloys.

This book will be valuable to newcomers to the field thanks to its explanations of the different properties of liquid metals, and also to senior researchers and engineers working with liquid metals or in parallel fields due to its large amount of experimental and assessed data.

Reviewer: Roberto Ribeiro de Avillez *of Pontifícia Universidade Católica do Rio de Janeiro, Brazil.*



Metamaterials: Beyond Crystals, Noncrystals, and Quasicrystals

Tie Jun Cui, Wen Xuan Tang, Xin Mi Yang, Zhong Lei Mei, and Wei Xiang Jiang

CRC Press, 2016
341 pages, $175.96 (e-book $153.97)
ISBN 9781482223101

Metamaterials are materials consisting of small manmade structures, "meta-atoms," arranged regularly (crystal-like) or randomly (such as in an amorphous material), similar to atoms in a conventional material. The focus of this book is the interaction of electromagnetic waves with these materials. The most famous metamaterials are those with a negative index of refraction and materials to be used for "invisibility cloaks." The theoretical description of the properties of these materials, explained in the introductory chapters, is based on Maxwell's equations and other laws and is derived therein from Maxwell's equations. This means that physicists and most materials scientists should have no difficulty following the mathematical descriptions.

The frequency range discussed in this book is limited to microwaves. A special chapter is devoted to each type of metamaterial, highly ordered super crystals, random metamaterials, super noncrystals, and inhomogeneous metamaterials called "super quasicrystals." Special groups of materials—gradient and two-dimensional metamaterials—are also discussed. The properties of each of these are discussed in detail. However, in most cases, the authors give only the final equations describing the properties and do not show enough to determine how to deduce them. In most cases, this is sufficient for the reader interested in applications. The synthesis of metamaterials is not described at all; the book is limited to the properties.

Even though the content of this book is based primarily on work conducted in the State Key Laboratory of Millimeter Waves at the Southeast University in China, the authors took care to include references to the international literature in this area. Each chapter is followed by a long list of articles from the literature. Visualization of the information is accomplished with a large number (203) of very instructive figures. This book is recommended to every materials scientist who wants to apply or learn more about this new class of materials. However, as this book (1) is largely limited to the interaction of electromagnetic waves with metamaterials and (2) does not cover questions of synthesis, it is not suitable as a basis for a course on metamaterials.

Reviewer: Dieter Vollath *of NanoConsulting, Stutensee, Germany.*

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