Andreas Öchsner, Graeme E. Murch,
Marcelo J. S. de Lemos (Eds.)

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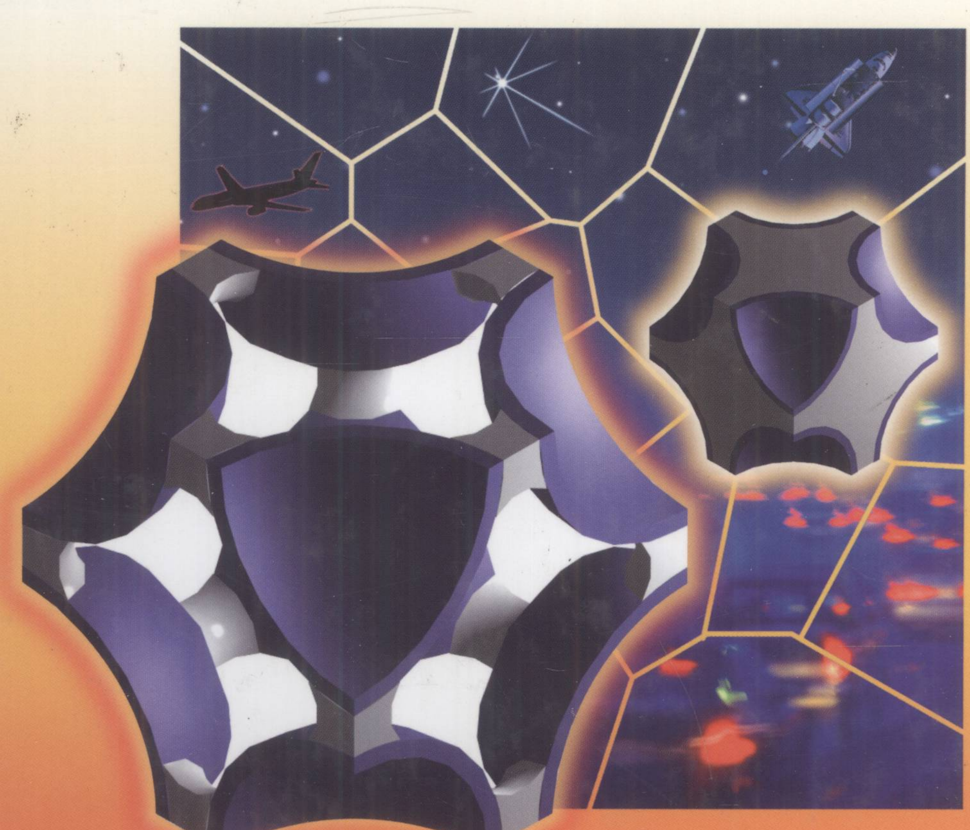
Thermal Properties Simulation and Prediction



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Further Reading

S. Kaskel

Porous Materials

Introduction to Materials Chemistry, Properties, and Applications

2009

ISBN: 978-3-527-32035-0

M.J. Sailor

Porous Silicon in Practice

Preparation, Characterization and Applications

2008

ISBN: 978-3-527-31378-5

M. Scheffler, P. Colombo (Eds.)

Cellular Ceramics

Structure, Manufacturing, Properties and Applications

2005

ISBN: 978-3-527-31320-4

Preface

Nature frequently uses cellular and porous materials for creating load-carrying and weight-optimized structures. Thanks to their cellular design, natural materials such as wood, cork, bones, and honeycombs fulfill structural as well as functional demands. For a long time, the development of artificial cellular materials has been aimed at utilizing the outstanding properties of biological materials in technical applications. As an example, the geometry of honeycombs was identically converted into aluminum structures which have been used since the 1960s as cores of lightweight sandwich elements in the aviation and space industries. Nowadays, in particular, foams made of polymeric materials are widely used in all fields of technology. For example, Styrofoam® and hard polyurethane foams are widely used as packaging materials. Other typical application areas are the fields of heat and sound absorption. During the last few years, techniques for foaming metals and metal alloys and for manufacturing novel metallic cellular structures have been developed. Owing to their specific properties, these cellular materials have considerable potential for applications in the future. The combination of specific mechanical and physical properties distinguishes them from traditional dense metals, and applications with multifunctional requirements are of special interest in the context of such cellular metals. Their high stiffness, in conjunction with a very low specific weight, and their high gas permeability combined with a high thermal conductivity can be mentioned as examples. Cellular materials comprise a wide range of different arrangements and forms of cell structures. Metallic foams are being investigated intensively, and they can be produced with a closed- or open-cell structure. Their main characteristic is their very low density. The most common foams are made of aluminum alloys. Quite a regular arrangement of cells is obtained in structures, e.g. with hollow spheres. A perfect regular structure results from interconnecting networks of straight beams; materials of this type are known as lattice block materials. What all these different cellular materials have in common is that their physical properties are not only determined by their cell wall material but also significantly by their microstructure.

Several textbooks cover the topic of cellular materials in general and give an introduction to the whole range of physical properties and possible applications. The books by L. J. Gibson and M. F. Ashby (Pergamon Press, 1988), M. F. Ashby *et al.*

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(Butterworth Heinemann, 2000), and H.-P. Degischer and B. Kriszt (Wiley-VCH, 2002) are recognized as standard works on this topic and give the most comprehensive general overview of cellular and porous materials.

The idea of this book is to cover one of the important physical characteristics, i.e. thermal properties, in detail from different points of view. This book aims to provide readers not only with a good understanding of the fundamentals but also with an awareness of recent advances in properties determination and applications of cellular and porous materials. The book contains 12 chapters written by experts in the relevant fields from academia and from major national laboratories/research institutes. The first part of the book introduces in detail different numerical and analytical methods in order to characterize and predict the effective thermal properties. Each of these chapters focuses on a detailed introduction of the theoretical and/or experimental method(s) which are applied to the characterization of different materials. The first part of the book introduces aspects relevant even for a non-specialist, i.e. to provide information which is normally omitted in the scope of journal publications. Different characterization approaches are presented and applied to different types of cellular and porous materials in order to reveal a spectrum for the investigation of effective thermal properties. The second part of the book addresses various types of applications and specialized topics related to the context of thermal properties of cellular and porous materials.

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January 2008

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