MATERIALS FOR ENGINEERS

This text is intended for a first undergraduate course in materials science and engineering with an emphasis on mechanical and electrical properties. The text features numerous useful examples and exercises. It differs from other available texts in that it covers topics of greatest interest in most undergraduate programs, leaving more specialized and advanced coverage for later course books. The text begins with phases and phase diagrams. This is followed by a chapter on diffusion, which treats diffusion in multiphase as well as single-phase systems. The next several chapters on mechanical behavior and failure should be of particular interest to mechanical engineers. There are chapters on iron and steel and on nonferrous alloys, followed by chapters on specific types of materials. There is an emphasis on manufacturing, including recycling, casting and welding, powder processing, solid forming, and more modern techniques, including photolithography, vapor deposition, and the use of lasers.

William F. Hosford is a professor emeritus of materials science and engineering at the University of Michigan. Professor Hosford is the author of a number of books, including the leading selling *Metal Forming: Mechanics and Metallurgy, Third edition* (with R. M. Caddell); *Mechanical Behavior of Materials* (Cambridge); *Intermediate Materials Science* (Cambridge); *The Mechanics of Crystals and Textured Polycrystals*; *Physical Metallurgy*; and *Reporting Results* (with D. Van Aken; Cambridge).

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CAMBRIDGE
UNIVERSITY PRESS

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University Printing House, Cambridge CB2 8BS, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314-321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi - 110025, India

103 Penang Road, #05-06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org
Information on this title: www.cambridge.org/9780521899970

First published 2008
First paperback edition 2014

A catalogue record for this publication is available from the British Library

Library of Congress Cataloging in Publication data
Hosford, William F.
Materials for engineers / William F. Hosford.
p. cm.
Includes bibliographical references and index.
ISBN: 978-0-521-89997-0 (hardback)
1. Materials – Textbooks. I. Title.
TA403.H627 2008
620.1′1 – dc22 2008007734

ISBN 978-0-521-89997-0 Hardback
ISBN 978-1-107-42051-9 Paperback

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Preface

The importance of materials to civilization is attested to by the names we give to various eras (Stone Age, Bronze Age, and Iron Age). We do not consider present times in terms of one specific material because so many are vital, including steel. The computer age would not be possible without silicon in computer chips.

Most introductory texts on materials science and engineering start with topics that are not of great interest to most engineers: atomic bonding, crystal structures, Miller indices. This introductory materials text differs from others because it is written primarily for engineers. It is shorter than most other materials texts so that it can easily be covered in one term. Emphasis is on mechanical and electrical properties of interest to most engineers. Thermal, optical, and magnetic behaviors are also covered. In addition, processing is treated in some detail.

Topics like X-ray diffraction, Miller indices, dislocations and coordination in compounds, surfaces, average molecular weights, Avrami kinetics, and Weibull analysis, which are of great interest to materials scientists but of little interest to most engineers, are covered only in the appendices. There is also an appendix on wood. There is no treatment of crystal systems, the Hall effect, or ferroelectricity.

After an introductory chapter, the text starts with phases and phase diagrams. This is followed by a chapter on diffusion, which treats diffusion in multiphase as well as single-phase systems. The next several chapters on mechanical behavior and failure should be of particular interest to mechanical engineers. There are chapters on iron and steel as well as nonferrous alloys. The chapters on electrical and optical properties should be of particular interest to electrical engineers. These are followed by chapters on specific types of materials: polymers, glasses, crystalline ceramics, clay products, forms of carbon, composite materials, concrete, and foams.

There is an emphasis on manufacturing, including recycling, casting and welding, powder processing, solid forming, and more modern techniques, including photolithography, vapor deposition, and the use of lasers. The text has been influenced by *Elements of Material Science* by L. H. Van Vlack and *Engineering Materials and Their Applications* by R. A. Flinn and P. J. Trojan. I want to thank David Martin for his help with polymers.