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MACMILLAN WORK OUT SERIES

Engineering Materials

V. B. John

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First published 1990

Published by
MACMILLAN EDUCATION LTD
Houndmills, Basingstoke, Hampshire RG21 2XS
and London
Companies and representatives
throughout the world

British Library Cataloguing in Publication Data
John, Vernon. 1931–
Engineering Materials
1. Materials

I. Title

620.1'1

ISBN 978-0-333-46372-7

ISBN 978-1-349-10185-6 (eBook)

DOI 10.1007/978-1-349-10185-6

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Acknowledgements

Grateful acknowledgement is made by the author and publishers to the following Institutions who kindly gave permission for the use of questions from their first year examination papers:

City University
Kingston Polytechnic
Polytechnic of Central London
University of Salford
Sheffield City Polytechnic
University of Sheffield
University of Southampton
Trent Polytechnic.

Any errors or omissions remain the responsibility of the author and publishers.

Introduction

Materials Science or Engineering Materials is a core subject in all engineering degree courses. This volume is designed to be used by students on engineering degree courses but it may also prove helpful to those studying for a specialist degree in materials science or materials engineering.

One of the aims of this book is to provide a guide for revision study of materials at first year undergraduate level. The content of this volume may appear to be very wide and contain more than first year work. This is because there is a wide variation between the curricula operated in different colleges. Topics which, in some institutions, feature in the second year of a course may be introduced in the first year of study at other colleges. Materials selection is one of the study topics which is introduced in a simple way at an early stage of some courses and this is reflected in this volume.

The summaries at the beginning of each chapter are intentionally neither greatly detailed, nor completely comprehensive. They are simply reminders of the more important facts or concepts with which you should be familiar. If this is not the case for a particular topic, you should refer back to your lecture notes and/or textbooks before going on to the worked examples.

Bear in mind that often there is not just one 'correct' answer to the examination question. Many questions could be successfully answered in several different ways. Thus, the 'worked examples' are not intended to be 'model answers', but are more of a guide to what the examiner is looking for. They also contain additional comments and discussion of particular points of interest or difficulty which should help to clear up some of the more common misconceptions or misunderstandings.

Symbols Used in the Text

<i>Symbol</i>	<i>Quantity</i>	<i>Preferred Units</i>	<i>Alternative Units</i>
a	lattice parameter	m	Å (1 Å = 10 ⁻⁸ m)
D	diffusion coefficient	m ⁻² s ⁻¹	
E	modulus of elasticity (Young's modulus)	Pa	N m ⁻²
F	force	N	
G	modulus of rigidity	Pa	N m ⁻²
K_c	fracture toughness	Pa m ^{1/2}	N m ^{-3/2}
M	atomic mass number		
N_0	Avogadro's number	6.023 × 10 ²⁶ kmol ⁻¹	
Q	activation energy	J kmol ⁻¹	
R_0	universal constant	8314 J kmol ⁻¹ K ⁻¹	
T	temperature	K	°C
T_g	glass transition temperature		
T_m	melting temperature		
t	time	s	min
Z	atomic number		
γ	surface energy	J m ⁻²	
ε	direct strain		
ε_n	nominal strain		
ε_t	true strain		
η	viscosity	Pa s	poise (1 poise = 10 ⁻¹ Pa s)
λ	wavelength	m	Å
ν	Poisson's ratio		
ρ	density	kg m ⁻³	
σ	direct stress	Pa	N m ⁻²
σ_{FL}	fatigue limit	Pa	N m ⁻²
σ_{TS}	tensile strength	Pa	N m ⁻²
σ_Y	yield stress	Pa	N m ⁻²
τ	shear stress	Pa	N m ⁻²
ΔK	stress intensity factor	Pa m ^{1/2}	N m ^{-3/2}
$\Delta\sigma$	cyclic stress range	Pa	N m ⁻²