

EIGHTH EDITION



MODERN PHYSICAL METALLURGY

**R.E. SMALLMAN
A.H.W. NGAN**



Modern Physical Metallurgy

Eighth Edition

R. E. Smallman

A. H. W. Ngan



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Modern Physical Metallurgy

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Preface

Previous editions have included aspects of materials science with chapters on polymers, ceramics and more recently introduction to biomaterials, sports materials and nano-materials. These subjects now feature more prominently in separate courses at undergraduate and postgraduate levels. With the growing attention to these material courses and the availability of specialized books on these areas, it was felt that coverage of all these different topics in one book did not do justice to their emerging importance. While the previous edition is still a useful introduction to the subject as a whole, it was decided to concentrate the new edition on the original area of physical metallurgy.

Modern Physical Metallurgy has been developed into 16 chapters. All the material of the previous chapters has been revised and in many cases enlarged. Included are re-worked separate chapters on Solidification, Introduction to Dislocations, Point Defect Behaviour, Diffusion, Interfaces and Grain Boundaries, Work Hardening and Annealing, Steel Transformation and Precipitation Hardening. A number of worked examples are included in each chapter together with a set of problems, the solutions to which are provided in a solutions manual.

The new edition will be useful at both undergraduate and postgraduate levels in Material/Metallurgy and Engineering Departments.

R.E. Smallman
A.H.W. Ngan

March 2013

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Acknowledgement is made to a number of publishers and researchers for kind permission to reproduce a number of diagrams from other works; these are duly noted in the captions.

About the authors

Professor R. E. Smallman After gaining his PhD in 1953, Professor Smallman spent 5 years at the Atomic Energy Research Establishment at Harwell, before returning to the University of Birmingham where he became Professor of Physical Metallurgy in 1964 and Feeney Professor and Head of the Department of Physical Metallurgy and Science of Materials in 1969. He subsequently became Head of the amalgamated Department of Metallurgy and Materials (1981), Dean of the Faculty of Science and Engineering, and the first Dean of the newly created Engineering Faculty in 1985. For 5 years he was Vice-Principal of the University (1987–1992).

He has held visiting professorship appointments at the University of Stanford, Berkeley, PA, New South Wales (Australia), Hong Kong and Cape Town and has received Honorary Doctorates from the University of Novi Sad (Yugoslavia), University of Wales and Cranfield University. His research work has been recognized by the award of the Sir George Beilby Gold Medal of the Royal Institute of Chemistry and Institute of Metals (1969), the Rosenhain Medal of the Institute of Metals for contributions to Physical Metallurgy (1972), the Platinum Medal, the premier medal of the Institute of Materials (1989) and the Acta Materialia Gold Medal (2004).

He was elected a Fellow of the Royal Society (1986), a Fellow of the Royal Academy of Engineering (1990), a Foreign Associate of the United States National Academy of Engineering (2005) and appointed a Commander of the British Empire (CBE) in 1992. A former Council Member of the Science and Engineering Research Council, he has been Vice President of the Institute of Materials and President of the Federated European Materials Societies. Since retirement he has been academic consultant for a number of institutions both in the United Kingdom and overseas.

Professor A. H. W. Ngan Professor Ngan obtained his PhD on electron microscopy of intermetallics in 1992 at the University of Birmingham. He then carried out postdoctoral research at Oxford University on materials simulations. In 1993, he returned to the University of Hong Kong as a Lecturer in materials science and solid mechanics, at the Department of Mechanical Engineering. In 2003, he became Senior Lecturer, in 2006 Professor and in 2011 Chair Professor. His research interests include dislocation theory, electron microscopy of materials and nanomechanics. He has published over 150 papers in international journals and was invited to numerous international conferences to present keynote lectures. He received a number of awards including the Williamson Prize (for being the top Engineering student in his undergraduate studies at the University of Hong Kong), Thomas Turner Research Prize (for the quality of his PhD thesis at the University of Birmingham), Outstanding Researcher Award at the University of Hong Kong, the Croucher Award and Rosenhain Medal of the Institute of Materials, Minerals and Mining. He also held visiting professorship appointments at Nanjing University and the Central Iron and Steel Research Institute in Beijing. He is active in conference organization and journal editorial work.

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