The solid–liquid interface

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EDITORS:
Professor R. W. Cahn
Applied Sciences Laboratory, University of Sussex
Professor A. J. Forty
Department of Physics, University of Warwick
Professor I. M. Ward
Department of Physics, University of Leeds

D. P. WOODRUFF
Lecturer in Physics, University of Warwick

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Preface

This book sets out to discuss the state of our knowledge of the solid–liquid (i.e. the solid–melt) interface. While the first objective is to understand the structure or properties of this interface in an equilibrium state, most experiments have been concerned with states in which the interface is moving, and most particularly solidification. The relatively recent need to be able to grow well-defined single crystals of many materials (particularly for semiconductor devices), often by growth from the melt, has generated research which has provided a much better understanding of the fundamental processes of this mode of crystal growth. At the same time, it has been appreciated that an improved understanding of these processes can help in understanding and controlling the structures of quite massive castings of metals.

Books already exist on the metallurgical applications of controlled solidification, and on the many specialised and complex forms of the melt growth technique applied to single crystal growth. Instead, this book attempts to cover the basic background physics associated with solidification and melting. As such it will not tell the reader how to go out and grow a single crystal or make a better casting; but it may allow him to understand better why certain precautions and methods are better than others in achieving this aim. The title of *The Solid–Liquid Interface* was chosen as indicating the viewpoint on the subject to be adopted. For example, the basic thermodynamics of solid surfaces is discussed and our rather limited knowledge of the interface in equilibrium is reviewed; regrettably, little is known in detail about the interfacial free energy of the solid–liquid interface and, more particularly, its anisotropy, and so its role in determining crystal growth behaviour has yet to be properly assessed. Another topic which is dealt with here in much more detail than in conventional texts on solidification is that of interfacial instability. The extremely complex shapes of dendritic growth forms encountered in castings originate because these forms are the simplest ones that are stable, and our understanding of the detailed fashion in which simpler shapes become unstable has greatly improved in the last few years. Finally, wherever possible, not only solidification, but also melting, has been discussed. The practical applications of our understanding of solidification are far more extensive than of melting,

but the two processes are closely related and an understanding of one can supplement an understanding of the other.

I should like to thank all those authors who kindly provided me with photographs from their publications, and elsewhere, which I have used in this book, and most particularly to Dr J. D. Hunt of the University of Oxford who not only provided me with many such illustrations but also offered helpful comments after an initial reading of the chapter on eutectic growth.

D.P.W.

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