graduate students, working with and studying polymers and even non-polymer tribological problems, as an excellent introduction into the electrophysical effects in friction and as a rare summary of quality studies of this phenomenon.

Dr. Norm V. Gitis
*Center for Tribology, Inc., Chairman*
*STLE Technical Committee on Tribotesting*
*1711 Dell Avenue, Campbell, CA 95008, USA*
*E-mail address:* gitis@cetr.com (N.V. Gitis)

PII: S1385-8947(00)00251-5

**Nucleation Theory: Basic Theory and Applications**
Dimo Kashchiev, Butterworth Heinemann, 529 pp., £75.00, hardback, ISBN 0-7506-4682-9

It is a long time since a book appeared on the topic of nucleation, and the field was in considerable need of one. Experimental and theoretical understanding of the nucleation of phase transitions has developed rapidly in the last decade, and while progress has been described in a number of review articles, nothing more ambitious has appeared. Dimo Kashchiev has now provided a volume describing some developments in the theory of nucleation, and how it can be applied to various common processes. These include the homogeneous and heterogeneous formation of new phases in two and three dimensions, and the book deals with droplet formation from vapours, solid phases from melts and solutions, and bubbles from liquid phases.

The range of applications is therefore, extensive. The range of theories is less so, since the discussion revolves around the continuum thermodynamical approach of Gibbs, whereby the evolving nucleus is represented as a continuous phase occupying a certain defined volume, plus a surface phase introduced to take account of the differences with respect to reality. It is assumed without comment that continuum methods, appropriate to large systems, apply to the cases of small nuclei.

There is a short but entirely adequate discussion of density functional methods, but little mention of molecular methods (except some rough models) and the techniques of statistical mechanics and phenomenological models are not included at all. Details of the precise definition of a nucleus (or more accurately a molecular cluster) therefore, do not really enter the discussion, apart from some comments on the choice of where to place the dividing surface. Nevertheless the author gives a masterful account of the methods of continuum thermodynamics, and applications of the resulting formulae.

A nice feature of the book is that it starts with a familiar example of a system capable of a first order phase transition, namely the van der Waals fluid. The thermodynamic driving force for the nucleation of this transition, and concepts such as the equilibrium line and spinodal decomposition are illustrated.

The thermodynamics and kinetics of nucleation are developed in such a way as to derive the so-called nucleation theorem. This important result allows nucleation rate data to be used to determine the size of the critical nucleus. Fragments of new phase are hard to create out of the old phase (unless conditions are suitable for spinodal decomposition), but the 'critical' nucleus is sufficiently large that is equally likely to grow into the new phase, or decay into the old phase. It is the 'activated complex' of nucleation processes, and is usually only a few tens or hundreds of molecules in size. The rate of creation of critical nuclei is linked directly to the observed rate of nucleation of larger particles or droplets.

The core of the book is devoted to the application of the nucleation theorem to stationary and non-stationary nucleation processes. In the former case it is the rate of nucleation, and in the latter case it is this rate together with the delay, or induction time that are examined in order to extract the critical size. The description of the method is followed by an analysis of actual experimental data. Data from some computer simulations are also studied.

Very recent developments in nucleation theorems, namely the use of nucleation rate data to obtain the energies of critical clusters as well as their size, have, unfortunately, been omitted. Surveys of the application of the nucleation theorem to multicomponent systems are also not included.

Nevertheless this is a valuable and well-constructed book. It contains a wealth of references to the nucleation literature, including many important papers from the former Eastern Bloc. This is a reflection of the author's experience and standing in the field. It discusses work that was hitherto distributed in various journals and the collection and expansion of this material as a book is extremely useful. It is a book for anyone wishing to get to grips with the core theoretical aspects of a difficult and often bewildering subject. The way it clarifies details of the thermodynamics alone makes it an absolute must for researchers working in the field of the nucleation of phase transitions.

Ian Ford
*Department of Physics and Astronomy*
*University College London, Gower Street*
*London WC1E 6BT, UK*

PII: S1385-8947(00)00288-6