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A Review of: "Introduction to Soft Matter: Synthetic and Biological Self-Assembling Materials, by I. W. Hamley"

Marina Ruths [a]

[a] Department of Chemistry, University of Massachusetts Lowell, Lowell, MA 01854-5047

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Book Review

Introduction to Soft Matter: Synthetic and Biological Self-Assembling Materials, by I. W. Hamley, John Wiley & Sons, Ltd., West Sussex, England, 2007; xi + 328 pages; $65.00; (paperback) ISBN: 978-0-470-51610-2.

This book provides a concise introduction to colloid science, with a stronger focus on the properties of polymers and liquid crystals than several textbooks commonly used in courses at the undergraduate level. Each topic is introduced at a level suitable for undergraduate students in chemistry, engineering, or materials science, and the last part of each chapter is dedicated to applications. Approximately a dozen problems are given at the end of each chapter, with their numerical solutions listed at the back of the book. References to more advanced or specialized textbooks are also given as suggested further reading. Compared to other textbooks aimed at a similar audience, (D. J. Shaw, *Introduction to Colloid and Surface Chemistry*, 4th ed., Butterworth, 1992, and H.-J. Butt *et al.*, *Physics and Chemistry of Interfaces*, 2nd ed., Wiley-VCH, 2006), surface and interfacial forces are presented more sketchily. Readers familiar with the book by Shaw will here find a book at a similar level of difficulty, but with a more in-depth description of polymers, liquid crystals, and the thermodynamics of micellization.

After a brief introduction, the main part of Chapter 1 describes characterization of colloidal systems by, primarily, scattering and spectroscopic techniques, followed by a short introduction to rheology and computer simulation methods. Chapter 2, the most extensive chapter in the book, is devoted to polymer colloidal properties. After a short description of different types of polymers and their conformation and characterization follows a concise review of the basic properties of polymer solutions, amorphous and crystalline polymers, and rubbers. This includes a derivation of the Flory–Huggins equation, a description of viscoelasticity, chain dynamics and the glass transition, and crystallization and melting. Among the more applied topics at the end of the chapter, descriptions of the properties of fibers, polymer blends, and electronic and optoelectronic properties are particularly worth mentioning.

Chapter 3 starts with a description of different types of colloids and a brief introduction to van der Waals and electrostatic double layer forces. After a description of experimental methods for determining particle size and charge, the DLVO theory is introduced, followed by a discussion of colloidal stability. This part connects well with the previous chapter on polymers. The last part of Chapter 3 is devoted to more detailed descriptions of various types of colloids, with an emphasis on foams and emulsions, including a discussion of the thermodynamics of emulsification. This naturally leads up to a concluding section on various types of food colloids.

A comprehensive description of different types of amphiphiles is presented in Chapter 4, followed by an introduction to surface and interfacial tension. This is followed by a short section on wetting and contact angle, which could have been more detailed, considering its practical use for surface characterization. The thermodynamics of micellization and different models for micelle formation are discussed quite extensively, as are the effects of surfactant type and solution conditions on the critical micelle concentration. A section on interfacial curvature and the surfactant parameter follows, leading up to a discussion of phase diagrams and lyotropic liquid crystals. The treatment here is more extensive than in many other undergraduate-level textbooks and ties in well with the following chapter.

Chapter 5 provides a classification of the different phases of thermotropic liquid crystals and describes their characteristics such as order and anisotropy, and their alignment through electric or magnetic fields or flow. This is followed by a discussion of the identification of different liquid crystalline phases through polarization microscopy and scattering techniques. Theories for orientational order are introduced, followed by explanations of elastic properties and phase transitions. The last part of this chapter describes the applications of liquid crystals in display technology and contains several good schematic drawings.

The last chapter, Chapter 6, discusses various types of self-assembled systems found in living systems. An introduction is provided to lipid membranes, DNA structure and condensation, protein structures and folding, and the structure of polysaccharides and glycoproteins. The treatment is by necessity quite brief, but it is a good starting point for further reading.

Because of its clarity, this book is a good introduction to colloid science. It contains the required physical chemistry at a level

appropriate for an undergraduate course, with a particularly good balance between polymer, amphiphile, and liquid crystal topics.

Marina Ruths
Department of Chemistry,
University of Massachusetts Lowell,
Lowell MA 01854-5047