An Introduction to Interfaces & Colloids: The Bridge to Nanoscience

by John C. Berg
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The title of this book indicates that it is an introduction to colloids and interfaces, but it is so much more than an introduction. The author also states that "This textbook seeks to bring readers with no prior knowledge or experience in interfacial phenomena, colloid science, or nanoscience to the point where they can comfortably enter the current scientific and technical literature in the area. The book is addressed to undergraduate and graduate students in science and engineering as well as to practitioners, although even high school students should enjoy parts of it." Trying, in a single book, to provide coverage from high school through science/engineering graduate students as well as practitioners is a daunting endeavor but one that the author has more than accomplished.

The book is divided into 10 chapters (nine technical areas and an introduction). The first three are devoted to interfacial phenomena (capillarity, thermodynamics of interfaces, and solid-liquid interfaces). Within these chapters such traditional topics as the Young-LaPlace equation, the Kelvin equation, Gibbs adsorption, the Langmuir isotherm, and Young's equation are covered. Less commonly covered topics are also included such as dynamic surface tension, liquid bridges/shared menisci, Janus particles, scanning probe microscopy, and inverse gas chromatography. Each chapter also contains detailed descriptions of pertinent measurement techniques (13 for interfacial tension, three for contact angle measurement, and seven for surface characterization).

The next four chapters deal with colloidal phenomena. The topical coverage includes colloidal characterization, electrical properties, colloidal interactions, and rheology. Again, usual topics such as characterization, sedimentation/Brownian motion, light scattering, double layer models (Helmholtz, Gouy-Chapman, Stern), DLVO theory, Newton's law of viscosity, and Einstein's theory of viscosity are covered. Also included are discussions of electro-acoustics, dielectrophoresis, optical trapping, and electro-steric stabilization. Again a large number of measurement techniques are included such as classical light scattering, Fraunhofer diffraction, Raman scattering, and DLS (including scattering from more concentrated dispersion).

The last two chapters cover emulsions and foams (including microemulsions) and interfacial hydrodynamics (including the Marangoni effect). As with all of the previous chapters the initial material is, as advertised, at a level appropriate for someone without significant experience in the area. The author's clear style and explanations quickly lead the reader to more advanced material, which a current practitioner may find challenging. Indeed, the more advanced material in each of the chapters could well be condensed into a "state-of-the-art" description of that topic.

All of this may well be beyond the grasp of high school and undergraduate students. What makes this book suitable for these students are the "Fun Things To Do" sections at the end of each chapter. These simple, hands-on experiments (floating paper clips, determination of the critical coagulation concentration, streaming potential) are the types of activities that are of interest for these students, yet do lead to a more in-depth knowledge when explaining the phenomena.

In using this text in a graduate-level colloids and interface course, I found that there is no way to cover all of the material in the text in one semester; it would be hard to give the material the attention it deserves in a year-long course. Instead, it serves as an excellent entry into the field, giving the student more than enough support to understand the concepts while simultaneously providing more advanced material to encourage them to delve further. As outstanding as this text is, I did find one area where I wish there was more coverage. The exercises in Appendix 1 were all easily answerable by referring back to the appropriate chapter. Perhaps this is because the coverage is comprehensive but, as an instructor, I would like to have seen some more complex problems. My students and I also had a disagreement with the author's listing of "The Top Ten" equations in the book (although there are actually eleven). How can the Poisson-Boltzmann equation not be among the Top Ten? If nothing else this does provide a teachable moment as the students can construct their own Top Ten then debate the merits of including certain equations while deleting others.

If one checks the Internet one will find comments about this book such as: "I have reviewed many books in the area of nanoscience and colloids, this is by far the best, it has no peer," or "Buy it and tell others." I heartily concur. Anyone working in the area of colloids/interfaces should have a copy of this book. It makes an excellent reference book if you are an advanced practitioner and an excellent text if you are just getting started.