flow persists. Thus far we have found no evidence of the existence of a liquid-crystalline phase in the near-surface region. This experimental observation does not seem to fit into any of the theoretical frameworks developed thus far for the instabilities, including the surface-dominated mechanism.

EPILOGUE

What started nearly thirty years ago as a classical continuum problem has evolved into a study of molecular interactions at surfaces, in my laboratory (which I have emphasized here) and others. We are following this path because our ability to study real processing problems at a molecular level is enhanced by tools which were previously unknown or unfamiliar to us.

Our goal is unchanged from what it was when we began, but our methodology is quite different. My students are routinely using a variety of surface-sensitive methods (those mentioned above and other microscopies and spectroscopies) to study the mechanics of polymer interfaces, as are those in other laboratories. My colleagues Arup Chakraborty and Doros Theodorou, and their counterparts elsewhere, are using powerful computational and theoretical methods to study polymer chain conformations and dynamics near surfaces because of their own interests in a variety of practical problems.

I believe a thorough understanding of polymer surface interactions will result in major advances in processing, not just in problems of extrusion instability but, more importantly, in our ability to tailor surfaces for specific processing functions. I remain convinced that many of the extrusion instabilities which we have been studying (for I do not believe there is just one, despite the common onset at about the same recoverable shear) are the result of surface interactions, and that this is a fruitful avenue for research. It is likely that other mechanisms (stress-induced phase transitions, for example) are also important, and the recurrent danger is to become so focused on one idea that we miss other possibilities. We have done this too often in the past.

ACKNOWLEDGMENT

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ChE book review

MICROHYDRODYNAMICS: PRINCIPLES AND SELECTED APPLICATIONS

by Sangtae Kim, Seppo J. Karilla

Butterworth-Heinemann, 80 Montvale Avenue, Stone, MA 02180; 507 pages, $69.95 (1991)

Reviewed by
C. Pozrikidis
University of California, San Diego

There has been a long-standing need for a comprehensive book that discusses analytical, asymptotic, and numerical methods for computing the motion of particles in creeping flows and that catalogues known solutions, which can be used as a reference by instructors, students, and researchers. This book satisfies that need and does so in a well-organized, meticulous, proficient, and imaginative manner. The topics presented in the book, along with those in the classical monograph by Happel and Brenner (Low Reynolds Number Hydrodynamics) should be required reading for students of fluid mechanics, colloidal science, and other engineering disciplines involving particulate flows.

The main theme of the book concerns the question of how to compute the structure and properties of creeping flow past a single particle or a collection of particles of arbitrary shape in the presence of solid boundaries, and the alternative methods for this computation. The answer is given in the various chapters that are organized according to the geometrical conditions surrounding the problem. In the interest of rigor and comprehension, the mathematical developments are introduced with an illuminating discussion of the general properties of creeping flow, including variational principles.

One important and pioneering contribution this book makes is an instructive discussion of boundary integral representations in a manner that is coherent, rigorous, and accessible to readers with a fundamental background in functional analysis and integral equation theory. The application of methods of functional analysis and operator theory to study the properties of the integral equations of Stokes flow will be a

delightful treat to readers with deeper mathematical interests and is likely to draw the attention of researchers in applied mathematics, as it has done in the analogous fields of elastostatics and elastodynamics. Furthermore, readers with an interest in the field of computational science will be intrigued by the discussion of advanced computational procedures for solving the integral equations describing flow past collections of particles with reference to parallel computation.

The book consists of nineteen chapters and is divided into four parts according to geometrical configuration. Each section is followed by exercises with varying degrees of difficulty, with the objective of supplementing and extending the theory and filling in the details.

Part I, "Governing Equations and Fundamental Theorems," introduces the equations governing creeping flow with suspended particles. It contains the first two chapters: "Microhydrodynamic Phenomena," and "General Properties and Fundamental Theorems." Uniqueness of solution, energy dissipation theorems and their application to estimate the forces exerted on particles, the boundary integral representation, and the mathematical origin of the multi-pole expansion method are discussed.

Part II focuses on the "Dynamics of a Single Particle." Exact and asymptotic solutions are presented via singularity and functional expansion methods in spherical coordinates, and the mobility and resistance problems are defined. This part concludes with a chapter on unsteady Stokes flow or linearized Navier-Stokes flow that contains some original contributions and indicates avenues for further development.

Part III considers "Hydrodynamic Interactions" (that is, flows in the presence of two or more suspended particles) and outlines methods for computing mutual hydrodynamic effects. The resistance and mobility problems for multiparticle systems are formalized, an instructive discussion of the method of reflections for well-separated particles is presented, and asymptotic methods for well-separated particles and particles with disparate sizes are discussed. Furthermore, the two-sphere problem is analyzed in an exhaustive manner. The last chapter in this part introduces the application of numerical methods to compute creeping flow in the context of the multi-pole collocation method.

Part IV is dedicated to developing and solving the integral equations that describe flow in a container with suspended particles. The five chapters in this part are grouped under the general heading "Foundations of Parallel Computational Microhydrodynamics." The properties of the integral equations arising from boundary integral representations of Stokes flow are discussed in detail, and a proper boundary integral formulation leading to integral equations of the second kind (called the completed double-layer representation) is developed. Some advanced concepts of functional analysis and operator theory are used to explain the procedures, and the book also provides adequate references for background reading. All this discussion is geared towards developing convergent iterative methods of solutions that can be carried out on parallel processors: each particle is assigned to a different processor, the problem is solved locally, and the processors communicate every few iterations to let the other processors know about the local behavior of the flow. The authors are generous enough to make computer programs available to the public (but note that there is an update on the procedures).

I highly recommend this book as a text for an introductory or advanced course on colloidal science, low-Reynolds-number hydrodynamics, boundary integral methods, or advanced scientific computing. Furthermore, in the opinion of this reviewer, the book belongs on the bookshelf of any chemical engineer who has a direct or a peripheral interest in fluid flow. ❐

ChE books received

Electron Paramagnetic Resonance: Elementary Theory and Practical Applications, by Weil, Bolton, and Wertz; Wiley Interscience, 605 Third Ave., New York, NY 10158; 568 pages, $79.95 (1994)

Intermediate Organic Chemistry, 2nd edition, by John Stowell; Wiley Interscience, 605 Third Ave., New York, NY 10158; 334 pages, $49.95 (1994)

Information Theory in Analytical Chemistry, by Karel Eckschlager and Klaus Danzer; Wiley Interscience, 605 Third Ave., New York, NY 10058; 275 pages, $64.95 (1994)

Low Energy Ion-Surface Interactions, Edited by J. Wayne Rabalais; Wiley & Sons, 605 Third Ave., New York, NY 10058; 594 pages, $120 (1994)

The Surface Science of Metal Oxides, by V.E. Henrich and P. A. Cox; Cambridge University Press, 40 West 20th St., New York, NY 10011-4211; 464 pages, $84.95 (1994)

Progress in Inorganic Chemistry, Vol. 41, edited by Kenneth D. Karlin; Wiley Interscience, 605 Third Ave., New York, NY 10058; 848 pages, $125 (1994)

Chemical Dynamics at Low Temperatures, by Benderskii, Makarov, and Wight; Wiley Interscience, 605 Third Ave., New York, NY 10158; 385 pages, $74.95 (1994)

Practical NIR Spectroscopy; With Applications in Food and Beverage Analysis, 2nd edition, by Osborne, Fearn, and Hindle; Wiley Interscience, 605 Third Ave., New York, NY 10158; 227 pages, $89.95 (1993)

Design and Anaysis of Experiments: Vol 1. Introduction to Experimental Design, by Hinkelmann and Kempthorne; Wiley Interscience, 605 Third Ave., New York, NY 10158; 495 pages $49.95 (1994)

Electron Paramagnetic Resonance: Elementary Theory and Practical Applications, by Weil, Bolton, and Wertz; Wiley Interscience, 605 Third Ave., New York, NY 10158; 568 pages, $79.95 (1994)

ERRATA

There were several errors in the spring-issue article detailing the history of the Corcoran Award:

- ▷ The venue for the first Corcoran Award was the Division banquet in the University of Cincinnati ASEE meeting, not the Lake Tahoe meeting (which was the venue for the second award to Bob Bird).
- ▷ Richard Felder's award winning paper was "The Generic Quiz" [*CEE*, **19**(4), 176 (1985)] and not his paper on cheating which was mistakingly cited.
- ▷ Table 1 also listed E. Dendy Sloan's affiliation as Colorado State University when it is, in fact, the Colorado School of Mines.

We apologize both to the individuals and to our readers for the errors.