

with illustrating examples. Definitions necessary to the understanding of fluid dynamics are introduced before derivation and description of the Navier-Stokes Equation. A discussion relating to turbulent flow follows. Convective mass-transfer is considered but not analyzed in depth.

One-dimensional compressible flow is discussed with special application to flow through nozzles. Free convective heat transfer, bubble dynamics, and two-phase flow are next considered. The last part of the text covers the analysis of heat exchangers, open channel flow, and flow through permeable media.

The appendix contains considerable physical properties and functions for use in solution of problems on the above topics. The basic equations are given in selected coordinate systems. At the end of each chapter, numerous problems are given for assignment, half of which have stated solutions. References are given at the end of each chapter for additional study.

The book should be considered by engineering departments for use in their junior-level transport phenomena course. However, as a text for chemical engineering students it lacks adequate depth in mass transfer and the use of

chemical reaction kinetics in the basic equations. Practicing engineers will only find this text useful for refresher courses in the elements of heat, mass, and momentum transfer.

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From Electrocatalysis to Fuel Cells, G. Sandstedt (ed.), Battelle Seattle Research Center by the University of Washington Press, Seattle and London (1972). 415 pages. \$12.50.

From Electrocatalysis to Fuel Cells contains 34 papers that were presented during an international seminar at the Battelle Seattle Research Center. The papers are separated into eight sessions (chapters) covering metallic fuel cell catalysts, nonmetallic fuel cell catalysts, acid fuel cells, alkaline fuel cells, high temperature fuel cells, implantable fuel cells, batteries as related to fuel cells, and development prospects for fuel cells. The separation of the papers into the respective sessions with each session summarized by the session

chairman greatly enhances the book's readability.

Generally the papers are outstanding—authored and presented by the leading international authorities on the respective subjects. In several instances, critical commentary is provided by other attendees lending further insight into the matter, as well as some humor.

This material is essential reading for any scientist or engineer presently involved in electrocatalysis, fuel cells, or metal-air batteries. The papers range from highly theoretical mathematical treatments to very practical discussions of hardware design. For those who have been associated with fuel cells for the past decade, this book provides a rather interesting historical perspective. For example, most of the papers dealing with basic research are authored by the European community, reflecting the decreasing research activities in this country. In fact, approximately one-half of the papers were authored by the Europeans. This ratio also suggests decreasing interest in fuel cells in the United States. Also of interest is the lack of presentation of any significant technical breakthrough. Some hope is placed in the phthalocyanines, carbides, and bronzes as replacements for noble metal catalysts. However, these materials are not new and to date have shown little in practical devices. Thus, in perspective one must question whether the fuel cell has failed the test of economic utility and is losing in the quest for government and industry funding.

Three of the papers warrant special comment. C. V. Bocciarelli's paper "Fuel Cells and the Theory of Metals" views the problem of electrocatalysis through the eyes of a solid state physicist and presents a refreshing perspective to the problem. While some aspects of the paper are somewhat naive, the approach is interesting and warrants attention.

K. D. Beccu's discussion of "The Characteristics of Metal-Air Systems" is one of the most comprehensive and current treatments of this subject available.

The final paper in the volume, "Some Basic Aspects of Electrocatalysis," by J. O'M. Bockris is a marvelous summary of the present status of electrocatalysis knowledge as well as the required direction for future electrocatalysis research.

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