

its lack of mathematical details. Nevertheless, most mathematical theories on chaos are addressed in a cursory manner such that an interested reader can get a flavor of the physical and geometric concepts behind the mathematics and pursue the details elsewhere. It is hence an excellent reference for a course on nonlinear dynamics.

The writing style is concise and clear, a welcome departure from the overly flowery language of some chaos expositors. Colorful graphics, a must for a book on chaos, are also present but they are mercifully kept to a bare minimum. The exercises after some chapters are rather simplistic and are probably unnecessary for this kind of book.

All in all, I enjoyed reading the book and strongly recommend it to beginning researchers, especially those interested in the physical aspects of chaos.

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Granular Matter: An Interdisciplinary Approach

Edited by A. Mehta, Springer-Verlag, New York, 306 pp., 1994.

This book compiles a collection of interdisciplinary approaches for studying granular matters, with focus on the physics of granular matters. For instance, discussions on self-organized criticality and the lack of characteristic time and length scales at the critical state are useful to those who can benefit from viewing these phenomena as "generic examples" and derive implications for their specific granular systems. The same comment also applies to several other topics covered in this book, such as the entropy of a powder and the hard-sphere model for colloidal suspensions. Some intriguing experimental and computer simulation results are presented. These include pattern formation in a hopper flow, packing geometry as a function of vibration, and mixing and segregation of different size granular solids. Mathematical modeling for these phenomena is still in its embryo and thus only sketched in this book. The last chapter of the book offers a view that is closer to the traditional engineering concept of granular matters than the

rest of the book. It discusses the possibility of modeling a granular matter as a continuum using the Mohr-Coulomb description or plastic theory with brittle and ductile fracture, as well as friction at walls. An overview of how to utilize micromechanics in the above three continuum modeling is also provided.

In summary, this book captures highlights of our current understanding of the physics of granular matters. Every chapter is written with great insight. It is a useful reference for those who are interested in knowing the complexity of granular matters, as well as our present approach in describing some complex phenomena arising from granular matters. It, however, is not for design engineers who handle granular matters.

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Polymeric Gas Separation Membranes

By R. E. Kesting and A. K. Fritzsche, Wiley Interscience Publishers, New York, 1993, XI + 416 pp.

When reviewing a book, I try to decide if I would be willing to spend my own money to buy it. My willingness to open my wallet increased as I progressed through this book. On p. 1, I encountered the statement: "We feel, furthermore, that in the case of rigid glassy polymers, particularly those with high glass transition temperature (T_g), a gas separation model incorporating the concept of fixed micropores is worthy of consideration. It is our contention that the related field of reverse osmosis has suffered from the widely held, but nevertheless debatable, concept that a given polymer exhibits intrinsic permeability and selectivity."

From a quick glance at this 416-page book, I anticipated some painful reading, since I am one of those people who suffer from this widely held concept. Fortunately, after this initial shocking statement, I found that the book was not extreme and contained useful data on new materials, membrane structures, and even complete module systems. The information on module systems was covered better than most other treatments of the topic; since it was the last chapter,

I closed the book with the feeling that it was worth adding to my library.

The information on materials, properties, and methods for making membranes was useful, but a bit questionable in places. I felt the authors ascribe too much importance to "transient templates" and the nonequilibrium nature of the glassy state compared to the intrinsic chemical backbone nature. They note that their perspective was biased by their experience in which a "new" material approach to membrane development was beaten by the program they helped pioneer at Monsanto, which has come to be known as the "prism α ." Their highly successful membrane formation work produced a three- to four-fold improvement in productivity with no loss in selectivity.

In my opinion, the competing "new material" program they compare to was *not* actually a new material in the normal sense of the word, but rather a partially chemically modified old material. Truly new materials have properly selected novel backbone structures derived from well-defined monomers. This is quite different from an *ad hoc* chemical post treatment modification of an already-formed asymmetric membrane such as that referred to by these authors. In fact, *both* new materials and new membrane formation processes are critical for continued advances in the gas separation field.

Despite their stated tendency to favor membrane formation and processing in the pursuit of advances in gas separation systems, the authors have done a nice job in summarizing the tremendous amount of data on new materials. They have also provided some useful insights and interpretations with regard to the effects of molecular structure on permeation and separation properties. From my perspective, however, a problem does exist with some of the discussions in Chapter 4 regarding "nodules" and microvoids. The authors stretch the bounds of polymer physics beyond where I personally feel comfortable in interpreting nonequilibrium aspects of glassy films and membranes. Discussions of the source of the nonequilibrium nature of glasses are confounded with the existence of highly questionable nodular structures supposed to exist in liquid solutions and even in the amorphous solid state. Thus, read these sections with a critical eye and with the understanding that some of the