ture references, and 95 critically reviewed patents extremely useful and informative.

This is not, however, the place to look for an understanding of the scientific fundamentals underlying the fascinating phenomenology of supercritical behavior. No attempt is made at addressing the physical (molecular) origin of such crucially important phenomena as large negative solute partial molar volumes (Chapter 11). Also lacking are thorough discussions on transport of heat, mass, and momentum in supercritical fluids, and on critical phenomena. The treatment of the density dependence of solubility in supercritical fluids provides an excellent example of the authors' approach. We are told that "... the authors of virtually all the previously mentioned review papers suggest that, to a first approximation, the solvent power of a supercritical fluid can be related to the solvent density in the critical region." This is followed by a qualitative discussion of the similarities existing between equilibrium solute mole fraction vs. pressure isotherms and solvent reduced density vs. reduced pressure isotherms. Indeed, it is true (and very useful to know) that solubility is "related to" density. But shouldn't a book subtitled "Principles and Practice" do more than inform us about useful facts? It goes without saying that these closing remarks originate from this reviewer's perception of a lack of correspondence between title and contents. The same book, subtitled "in Practice," would have earned my unreserved commendation. If, in other words, you are interested in what to do with a supercritical fluid and how to do it, but not in understanding how things behave as they do, ignore the contested sub-title, forget this last paragraph, and buy the book.

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Supercritical Fluid Technology

Edited by J. M. L. Penniger, M. Radosz, M. A. McHugh, and V. J. Krukonis, Elsevier, 1985, 464 pp.

Supercritical Fluid Technology is a collection of papers devoted to various topics relevant to researchers and practitioners in this field. The volume is divided into four sections: thermodynamic modeling of supercritical fluids, experimental data and techniques, process development, and special applications.

The papers in the first two sections cover a wide range of phenomena and analyses and deal with some unusual topics such as retrograde solubility behavior and its potential significance in separation process design, continuous thermodynamic models and the particular relevance of partial and excess properties for understanding the thermodynamic behavior of the supercritical fluid phase. A number of papers on various equations of state modeling approaches are given; however, the virtues of using one approach over another are not made clear. A recent survey paper on comparative studies of equations in both the near-critical and more dense regimes would have been a useful addition to this section.

The experimental section contains excellent papers covering technique and analyses for both thermodynamic and transport properties in supercritical fluids. It covers a wide variety of systems with their unique features, ranging from polymer-supercritical fluid mixtures (i.e., polystyrene, toluene, carbon dioxide) to the ternary isopropanal, water, carbon dioxide.

The last two sections are process-oriented, involving systems and processes considerably more complex than those discussed in the preceding sections. They include a number of processes, from coal liquefaction to biomass hydrolysis.

The papers have been generally well written, edited, and presented. This valuable volume helps gain a broader perspective of some of the issues of current concern in the supercritical fluids area.

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Temperature Programmed Reduction for Solid Materials Characterization

(Chemical Industries Series, Volume 24)

By Alan Jones and Brian D. McNicol, Marcel Dekker, Inc., 1986, 208 pp., $59.75

Temperature-programmed reduction (TPR) is a relatively new technique for solid materials characterization. In this book, Jones and McNicol review the various aspects of the technique. As stated in the preface, it is intended as an informative guide for both experts and initiates in the field. It is divided into five chapters. After a short introduction to the technique in chapter 1, the underlying theory of TPR is discussed in chapter 2. Chapter 3 is a short chapter describing the required instrumentation. In Chapter 4 applications of TPR to a wide variety of systems are discussed at length. Chapter 5 is a short discussion of future developments in TPR.

The emphasis of the book is on the use of temperature-programmed reduction to characterize heterogeneous catalysts. However, the book correctly points out that TPR is applicable to other solid systems as well.

Chapter 4 on the numerous catalyst systems to which TPR has been applied serves as an excellent reference to the TPR literature. In the section on supported monometallic materials, the use of TPR as a valuable diagnostic tool in catalyst preparation and regeneration is discussed in detail. Unfortunately, most of this chapter, especially the section on zeolites, simply presents examples of TPR spectra and their interpretation. Little attention is paid to describing how that information is derived from TPR spectra. In most cases, the conclusions could not have been drawn from the TPR results alone. This chapter would have been far more informative if the use of other techniques in conjunction with TPR results were discussed. Then, when examples were given, the authors should have explained what other techniques were used and how those results were combined with the TPR results to arrive at the conclusions.

The weakest point of this book is that the authors do not emphasize that TPR is just one of several temperature-programmed techniques which can be used for catalyst characterization, all of which are variations on temperature-programmed-desorption (TPD). In TPD, a catalyst is predosed with an adsorbate, and its temperature is increased linearly in time. Desorption occurs either in vacuo or into a carrier gas which flows over the catalyst, and the desorption products are monitored. In TPR, as described in this book, the carrier gas is replaced by a reducing gas, typically hydrogen, which flows over an oxidized catalyst. In this case, hydrogen consumption is monitored while the catalyst temperature is increased. In chapter 3, the authors mention that they are not aware of any examples in which TPR was done where the products were monitored. Only as a future application in chapter 5, do they mention the desirability of monitoring the products with a mass spectrometer (residual gas analyzer). This is done routinely in TPD and temperature-programmed-surface-reaction (TPSR). Moreover, by using a mass spectrometer, the same system that is used for TPR could easily be used for TPD and TPSR, as well as steady-state and transient reaction studies. Thus, even though a mass spectrometer is more expensive, the extra flexibility it provides makes it indispensible in a modern TPD or TPR system.

In summary, this book serves as an excellent reference to the TPR literature which makes it valuable to someone who has experience with the technique. However, the book does not do a very good job of demonstrating to the novice how to use TPR and other temperature-programmed techniques to characterize solid materials.

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