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BOOK REVIEWS

The Physical Basis for Heterogeneous Catalysis. Edited by E. DRAUGLIS AND R. I. JAFFEE. Plenum Press, New York, London, 1976. 596 pp., $45.00.

The book contains the proceedings of the 9th Battelle Colloquium in the Material Sciences, held in Gstaad, Switzerland, September 2–6, 1974.

The contributions are divided into five subsections: (1) Experiments on Clean Metal Surfaces with Adsorbates, (2) Theory of Chemisorption, (3) The Effect of Small Particles and Porous Carriers, (4) Kinetics and Transport, and (5) Applications to Catalysis.

The list of authors and topics gives an indication of the quality of the contributions: P. H. Emmett, Autobiographical Remarks; P. H. Emmett, Fifty Years of Progress in the Study of the Catalytic Synthesis of Ammonia; C. Wagner, Thermodynamics of Adsorption; G. C. Bond, The Specification of Active Centers in Metal Catalysts; J. T. Yates *et al.*, The Use of X-Ray Photoelectron Spectroscopy (*ESCA*) for Studying Adsorbed Molecules; T. A. Clarke *et al.*, The Interactions and Reactions of Alkenes on Single-Crystal Surfaces of Platinum and a Comparison of Some Reactions in Homogeneous and Heterogeneous Catalysis; S. Andersson, Alkali Atom Adsorption on Nickel—Structure and Electric Excitations; M. B. Webb *et al.*, Low-Energy Electron Diffraction Studies of Clean and Overlayered Surfaces; H. D. Hagstrum *et al.*, Orbital Energy Spectra Produced by Sorbed Atoms; G. Ertl, Molecular Interactions in Adsorbed Layers; E. W. Plummer, The Applicability of Electron Emission Spectroscopy to Elucidate Chemisorption; D. W. Bassett *et al.*, Field Ion Microscope Studies of Interactions Between Atoms Adsorbed on Tungsten (110) Surfaces; R. P. Messmer, Theoretical Studies of Metal Aggregates and Organometallic Complexes Relevant to Catalysis; W. Kohn, Density Functional Theory of Metal Surfaces and of Chemisorption on Metals; J. R. Schriefer *et al.*, Theory of Chemisorption in Relation to Heterogeneous Catalysis; M. Boudart *et al.*, Catalytic and Magnetic Anisotropy of Iron Surfaces; G. Walter *et al.*, Characterization of Porous Materials, in Particular Raney Platinum; J. H. Block *et al.*, Field Ionization at Surfaces Investigated by Mass Spectrometry; G. A. Somorgai *et al.* The Mechanism of Hydrocarbon Catalysis on Platinum Crystal Surfaces; E. Drauglis *et al.*, Theory of Energy and Momentum Exchange Between Neutral Gas Atoms and Metal Surface; H. Suhl, Reactions Catalyzed Near Second Ordered Phase Transitions of the Substrate; D. Menzel, Isothermal Desorption Measurements; L. D. Schmidt, Condensation Kinetics and Mechanisms; R. P. Eischens, Classical Methods in Catalysis Research; P. Wynblatt *et al.*, Particle Growth in Supported Catalyst; K. Tamaru *et al.*, A New Method to Elucidate the Mechanism of Heterogeneous Catalysis by Means of Microwave Spectroscopic Techniques; W. Haidinger *et al.*, Experimental Results Relating to the Influence of Hot Electrons (Electrical Current Flow Through the Catalyst) on Catalyzed Reactions.

On the average the authors list 30 references. Unfortunately, in a few cases, this number drops below 15. The lack of sufficient references and the relatively short subject index may be considered a shortcoming by some readers.

Each paper (except for one) is followed by a discussion section. The questions and comments as well as the answers help to understand the problems involved, point out shortcomings, and may dampen some exaggerated optimism. These discussions as well as the agenda discussions, which follow each of the five subsections and summarize their contents, definitely increase the value of the book.

One may be mislead by the title of the book and may expect a wider range of coverage than a publication of this size can contain: A number of major techniques for surface analyses are described, but not all of them; the investigated samples are in most cases restricted to simple unsupported metals (not too many alloys and hardly any compounds), and the theoretical models are naturally restricted in a similar fashion. Since most studies were performed at low gas pressures, there still exists, as one author puts it, a "pressure gap" between these studies and applied catalysis.

How can the knowledge offered by this publication help the scientist wh is studying practical problems of catalysis? If one does not set "practical" equal to

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"commercial utility," the answer is given by R. P. Eischens: "It is, therefore, more realistic to assign practicality to experiments that produce information helpful to catalytic chemists. This requirement implies that the information gained in studies of bulk metals or thin films should be transferrable to supported metals. The catalytic chemist is confident that there is no obstacle to this transfer, so it is easy for him to accept the information produced in studies of transition metals by surface physicists."

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Magnetic Resonance in Colloid and Interface Science. Edited by HENRY A. RESING AND CHARLES G. WADE. ACS Symposium Series, Vol. 34, American Chemical Society, Washington, D.C., 1976. 541 pp., $25.50.

This volume is a collection of papers presented at a symposium sponsored by the Divisions of Colloid and Surface Chemistry, Physical Chemistry, and Petroleum Chemistry at the 172nd Meeting of the American Chemical Society in San Francisco, August 1976.

The papers included cover a remarkably wide range of topics, from EPR of semiconductors, through self-diffusion in liquid crystals, to proton relaxation of water in muscle tissue. Workers in the area of heterogeneous catalysis will find approximately 20 of the 42 papers to be of direct interest. Four papers deal with NMR studies of zeolites. Of particular note here is the application of magnetic resonance from nuclei other than protons. Sefcik *et al.* have used ^{12}C-NMR to identify adsorption states of molecules such as CO_2, CS_2, COS, and CO in small-port mordenite. Genser describes the observation of ^{23}Na and ^{27}Al resonances in NaY zeolite. Papers by Pfeifer and Basler are concerned with the more conventional proton NMR spectra of molecules adsorbed in zeolites. Also in the field of zeolites is a paper describing EPR studies of alkyl and amino radicals trapped in zeolite A and a detailed study by Rees of the Mossbauer spectra of ferrous-A zeolites.

Adsorption on clay minerals is covered in papers by Conard (NMR), McBride, and Pinnavia (EPR). Fripiat discusses NMR studies of proton exchange on oxide and silicate surfaces, while Kazansky and Fraissard describe their respective NMR investigations of chemisorbed surface complexes undergoing rapid exchange with physically adsorbed species. The use of multiple-pulse single and double resonance techniques to separate out the various interactions contributing to line shape and relaxation effects in NMR spectra of adsorbed molecules is described in an interesting paper by Vaughan. Brey and his co-authors describe the characterization of a thorium oxide catalyst by a combined NMR and EPR study. The investigation of semiconductor surfaces by EPR is comprehensively reviewed by Haneman, while NMR and EPR studies of silicon surfaces in particular are dealt with by Caplan.

The reviewer also found much of interest in some of the papers covering topics outside the field of heterogeneous catalysis, such as the review by Tanner of spin–echo measurements of self-diffusion in colloidal systems and the account, by Lindblom, Wennerstrom, and Lindman, of the NMR quadrupole splitting method for studying ion binding. The stated objective of the Symposium, to present a current statement of research in the area of the title, appears to have been well met. The collected papers will provide a valuable reference for workers in many different disciplines.

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