

BOOK REVIEW

**Infrared Spectroscopy in Surface Chemistry.**  
By MICHAEL L. HAIR. Marcel Dekker, Inc. New York, 1967. xii + 315 pp. Price \$15.75.

No technique has been more widely and enthusiastically applied to surface studies during the past dozen years than has infrared spectroscopy. The literature in this field continues to increase rapidly and has become difficult for even the specialist to follow. As is usual in a new field, more questions have been raised than answered, and much confusion and some controversy have appeared. The need for a coherent review of progress to date is evident, and the present book appears to fill this need very well.

The book reviews infrared studies of surfaces from their inception over 20 years ago through 1966. It emphasizes those subjects closest to the author's own interests, particularly oxide surfaces, and stresses interpretations and hypotheses which either accord with his own or seem particularly provocative (even if probably incorrect). Three introductory chapters provide enough background in surface chemistry, infrared spectroscopy, and experimental techniques for the novice or general reader. These are followed by three major chapters covering surface studies on silica, acidic oxides, and metal-metal oxide systems, the last being the shortest. Three short chapters, covering miscellaneous surfaces, other infrared and Raman techniques, and new applications, conclude the book.

In his preface the author states that application of the infrared technique to surface studies has been largely pioneered by scientists primarily interested in explaining the nature of catalytic activity, and he concludes that their "efforts in this direction have had minimal success" although contributing significantly to the general understanding of surface phenomena. Although this is true, the possible implication that infrared studies offer no hope for elucidating the nature of catalytically active sites cannot go unchallenged. It is obviously more difficult to characterize the catalytically important features of a surface than to gain general information about its chemistry. Fairly complete understanding of the surface

chemistry may in fact often prove a prerequisite to understanding the nature of active sites. Since infrared spectroscopy can yield highly detailed information about surfaces, no other technique now offers as great promise for ultimate understanding of active sites.

The contributions of infrared studies to surface chemistry are undeniable. It is also clear, however, that much that has been done to date will have to be carefully redone, and that many of the conclusions are wrong. This book seems to succeed rather well in presenting current hypotheses and controversies lucidly so as to interest new workers in the field and inspire the crucial experiments needed for further progress. The author emphasizes the tentative nature of much of the material and encourages the reader to think deeply about some of the interpretations.

The book is, on the whole, well-edited, and the makeup and printing are very good. It contains a fair number of small errors, however (most of which should have been caught in proofreading), and can be puzzling in spots. (On page 2, for example, the distribution of zinc and sulfur atoms in a crystal of zinc sulfide is twice indicated to represent a "state of maximum entropy.") It can be read with interest and profit by most chemists interested in surfaces, but seems particularly designed to interest new workers in surface chemistry. It could be quite valuable as a supplementary text for an upper division or graduate course in surface chemistry or catalysis.

It is impossible to avoid comparison with L. H. Little's recent book ("Infrared Spectra of Adsorbed Species," Academic Press, 1966). Although both cover the same ground there are major differences in presentation and emphasis. Neither is as critical as might be hoped. Hair's book is somewhat shorter and seems much superior in organization and clarity of presentation. It also profits from inclusion of important work published in 1965 and 1966 not covered by Little's book. The latter, although more comprehensive, tends to be awkwardly organized and is often repetitive. Little devotes more attention to studies using oxide-supported metals. His book

appears to be directed toward the expert rather than the novice, and, from this standpoint, it is made uniquely valuable by the supplementary chapters (by A. V. Kiselev and V. I. Lygin) covering Russian studies. Both books are, of course, of prime interest to anyone working in the field, but Hair's seems to provide a more

readable and interesting introduction to the use of infrared spectroscopy in surface studies.

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