which is itself denoted by ≠. When we have understood a chemical reaction like $F + H_2$ or $O + H_2$ in terms of the individual resonance states of the intermediates, we have reached the ultimate level of intimacy allowed by quantum mechanics. In 1994 this is the state of the art, to which this book provides the background and the anticipations.

The current shift in chemical kinetics—from viewing the decomposition of intermediates in circumstances where the fragmentation is controlled by statistical theories based on densities of states, to viewing individual quantum states whose "partial widths" determine individual transition probabilities $P_{\alpha \to k,l}$—is similar to the paradigm shift that occurred in nuclear physics when the liquid-drop and early compound-nucleus theories were developed to the stage of Herman Feshbach's treatment of individual resonance states.

A fascinating aspect of current work on photodissociation dynamics is the increasing use of the time domain in computations. The benefit of switching from a state-selected, time-independent description involving steady-state boundary conditions to the time domain follows from the well-known trade-offs between frequency and time domains in Fourier analysis. The relevance of these trade-offs to photodissociation was elucidated in a series of papers by Eric Heller in the late 1970s. Heller noted that many of the most important aspects of a dissociation process, such as which products will be formed and which electronic quantum numbers the products will have, are often determined on a time scale on the order of 10 femtoseconds. Thus their signature in the spectroscopic observables should involve only the broad features of the dissociation spectrum. Working with well-resolved individual eigenstates may then entail an unwarranted degree of overkill, not to mention making the problem computationally intractable. Thus the time-dependent propagation of wavepackets implicitly containing a host of unresolved states has become the preferred description in many cases.

The last chapter of the book discusses recent experiments by Ahmed Zewail in which a dissociated wavepacket is observed in real time. Because a movie can be much more revealing than even the most intimate photograph, new results in this area should be very stimulating; Schinke's book provides a suitable introduction—to be read now by those who wish to avoid future shock or by those who wish to start participating. First-year graduate students among the latter should not find the level of difficulty of the theory beyond their reach.

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Interferogram Analysis: Digital Fringe Pattern Measurement Techniques

Edited by David W. Robinson and Graeme T. Reid
IOP, Philadelphia, 1993.
304 pp. $118.00 hc
ISBN 0-7503-0197-X

Those of us who make our livings generating and analyzing interference fringes will welcome this new book, which gathers together important information that will make it easier for us to do our work. The editors intended *Interferogram Analysis* to be a useful reference for postgraduates and researchers in the increasing number of fields that use fringe patterns for measurement. The success of their efforts was proved to me when I used the book as a resource to solve real-world problems even before I had finished reviewing the text for PHYSICS TODAY.

Interferometry has been around for a long time. Nonetheless, digital methods have revolutionized the art, making it possible to extend the measuring power of interference phenomena to new applications. The editors are quite right to feel that the field has matured enough to merit a book of its own. Their general organization of the book is well thought-out, starting with a brief tutorial on digital methods of image processing and proceeding to an overview of the many different ways to generate and analyze fringe patterns. The chapters cover intensity-based methods of fringe interpretation, phase-shifting interferometry, spatial phase measurement, analysis method in laser speckle photography and particle image velocimetry; a brief outline of applications is also included. There are many illustrations and a long list of references for further study. Each of the chapters is authored separately, but there has been an obvious attempt to provide a smooth transition from one topic to the next, and it is possible to read the book from beginning to end without disorientation.

One of the strengths of *Interferogram Analysis* is its recognition that diverse forms of metrology, including Fizeau interferometry, shadow moiré, electronic speckle pattern interferometry and double-exposure holography, share a common set of signal processing problems. For example, no matter what physical principle leads to the generation of a fringe pattern, it is almost always necessary to sort out the various fringe orders and "unwrap" the pattern before it can be rendered in a meaningful form. The phase-unwrapping problem is dealt with in a very useful chapter by David Robinson, who quite correctly omits any diagram of an experimental apparatus for generating fringes. This tendency to generalization might be a source of frustration for some readers, but there is not enough space in the book to cover any one metrology means thoroughly.

In addition to generalizing the source of fringe patterns, the editors are equally noncommittal when it comes to understanding the meaning of finished product of fringe analysis. Some readers versed in optical testing will be shocked to discover that there is no discussion of Zernike polynomials in a book devoted to interferogram analysis. For this reason and many others, the book should be considered a supplement to more complete and well-established texts, such as Daniel Malacara's excellent *Optical Shop Testing* (Wiley, 1992).

Because the object of the editors was to gather information from diverse areas under the umbrella of digital fringe analysis, it is not surprising that there is little that is actually new or invigorating in the final product. Some chapters are expanded or reworked versions of review articles, others are condensations of books by the same author, and at least one of the chapters has already appeared in a previously published book in nearly the same form. Nevertheless, *Interferogram Analysis* is a convenient compilation of ideas and techniques developed over the last few years. I know I will use it, and others with a serious interest in digital fringe analysis will also find it a worthwhile addition to their libraries.

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Semiconductor Surfaces and Interfaces

Winfried Mönch
Springer-Verlag, New York, 1993. 366 pp. $79.00 hc
ISBN 0-387-54423-2

A tremendous amount of attention has been directed over the past several years toward the study of semiconductor surfaces and interfaces. As noted in the foreword of this monograph by Winfried Mönch, the subject uniquely combines aspects of physics and chemistry in addressing important questions on which new technologies may be based. This is particularly the case in microelectronics and optoelectronics where, with a view towards advanced applications, there has been a concerted effort to develop a fundamental, atomistic understanding. Progress in both theoretical sophistication and the development of experimental probes, notably scanning tunneling microscopy, have led to other advances that make possible the fabrication and eventually the use of epitaxial, atomic-scale structures in devices.

For example, several monographs and edited volumes by Simon Min Sze and others have already been devoted to discussion of microelectronics device theory, fabrication and application. Similarly, surface physics has been discussed in other texts, such as *Physics At Surfaces* by Andrew Zangwill (Cambridge, 1988). Mönch's monograph is unique, however, because his focus on the fundamental aspects of semiconductor surfaces and interfaces develops the subject from the point of view of a surface scientist who himself has made several important contributions in this area. In this regard, it builds a bridge from surface science to electronic-device applications.

The book starts with a brief but well-developed historical introduction, extending back to the discovery of rectification in 1874. The subsequent set of chapters presents the theoretical aspects of semiconductor surfaces, including space charge, surface states, band bending and surface photovoltage effects. This segment is properly completed with a chapter discussing interface states existing in metal–semiconductor and semiconductor–semiconductor structures.

The next group of chapters catalogs the properties unique to each class of semiconductor surface, thoroughly discussing the theoretical and experimental background and the general implications of those properties. The well-known structural reconstructions associated with semiconductor surfaces, including their unique electronic and vibrational properties, become the central focus, and the physical insights into the driving forces of the reconstructions are described quite clearly. Of particular interest is the description of recent work in the study of various structural phases of Si(111) and Ge(111) surfaces, especially thermally driven phase transitions probed by various structural and spectroscopic techniques.

This segment is followed by a discussion of deposition of metallic and nonmetallic species on semiconductor surfaces. Here, the author provides an excellent background on adsorbate-induced semiconductor surface reconstructions, as well as an atomistic view of adsorption. The latter serves as a basis for semiconductor surface processing, and the two chapters that follow are devoted to oxidation and passivation, respectively.

Theoretical and practical aspects of semiconductor interfaces are discussed in the book's final chapters. For metal–semiconductor interfaces, a general overview of the observed deviations from the Schottky–Mott theory is presented. To assess the Schottky-barrier heights of atomically abrupt expitaxial interfaces, the author discusses the relevance of both interfacial geometric and electronic structures. To complete the monograph, semiconductor heterojunctions are discussed briefly.

Semiconductor Surfaces and Interfaces provides a readable and comprehensive discussion of its subject. With its extensive set of references, the book could serve as an excellent text for a graduate-level course in surface science, where the emphasis would be on electronic materials, or as a reference book for scientists in the field. While the book is virtually up to date, a new edition might include related recent progress in, for example, the manipulation of atoms on semiconductor surfaces and probing of the resulting local electronic structure; the use of variable-temperature scanning tunneling microscopy to monitor phase transitions on the atomic scale; and the theoretical and experimental treatment of the Schottky-barrier problem at disordered interfaces.

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High-Energy Solar Phenomena—A New Era of Spacecraft Measurements. *AIP Conference Proceedings 294.* Proc. Wksp., Waterville Valley, N. H., March 1993. J. M. Ryan, W. T. Vestrand, eds. AIP, New York, 1994. 246 pp. $110.00 *hc* ISBN 1-56396-291-8

Solar and Planetary Dynamos. M. R. E. Proctor, P. C. Matthews, A. M. Rucklidge, eds. Cambridge U. P., New York, 1994. 366 pp. $49.95 *hc* ISBN 0-521-45470-0

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