ADVANCED MATERIALS

Book Reviews

Microbeams, Surfaces and Sieves

Spectroscopy of Surfaces. Edited by *R. J. H. Clark* and *R. E. Hester*. Wiley, Chichester 1988. xxi, 488 pp., bound US $ 190. – ISBN 0-471-91895-4

This book gives a comprehensive review on the state of the art in selected surface spectroscopies. Except for the chapters by *J. C. Vickermann* on Static Secondary Ion Mass Spectroscopy and by *F. P. Netzer, J. A. D. Matthew* and *E. Bertel* on Electron Excited Surface Spectroscopies, vibrational spectroscopies are discussed. The articles describing the principles and theoretical background of Raman-, IR-reflection absorption-, Inelastic Tunneling- and High Resolution Electron Energy Loss Spectroscopy are comprehensive and clearly written. The book is a good introductory text for advanced graduate students and a useful reference text for researchers in surface and interface science.

The first chapter "Structure and Orientation in Thin Films: Raman Studies with Integrated Optical Techniques" is written by *J. F. Rabolt* and *J. D. Swalen* who pioneered the use of optical spectroscopies to probe organic thin films prepared by Langmuir-Blodgett techniques or by self-assembly through adsorption on a solid surface. They describe the theory of Waveguide Raman Spectroscopy (WRS) starting from basic principles and discuss layered structures to which the technique can be applied. Examples are given to show how different modes of the light beam can be used to emphasize the signal from different layers of the thin films and how polarization dependent measurements are used to determine the molecular structure in thin films. The application to adhesion studies and molecular interactions between thin films is demonstrated for a poly(vinylalcohol)/poly(methylmethacrylate) (PVA/PMMA) composite wave guide.

In chapter two "The Selection Rules for Surface-Enhanced Raman Spectroscopy (SRS)" by *J. A. Creighton* the different physical mechanisms leading to the SERS effect are explained. Their relative contributions to the resulting enhancements are discussed with reference to the spectra of molecular adsorbates at metal-electrolyte and metal-gas interfaces. In a clear and concise way the criteria to distinguish between electromagnetic, resonance and modulated charge transfer enhancement are described and suggestions for further experiments are given. Utilizing the SERS effect to determine the orientation in adsorbed organic films is clearly one of the future applications of the technique.

T. M. Cotton reviews the application of SERS to biological systems in her chapter "The Application of Surface Enhanced Raman Scattering in Biochemical Systems". As an introduction to the subject, she summarizes the theories of electromagnetic and charge transfer enhancement and the experimental aspects of SERS. The biological application of SERS are demonstrated with data obtained for DNA, proteins, lipids and studies of the interaction of dissolved enzymes with coenzymes and substrates. Absolute detection limits in the picogram range have been achieved for aromatic compounds and dyes which make SERS a powerful analytical technique in materials science.

In chapter four *J. C. Vickerman* reviews Secondary Ion Mass Spectrometry (SIMS) and discusses new applications in surface science and materials analysis. Static SIMS applied to the study of thermodynamic quantities in adsorbed layers, and imaging SIMS are two examples in this comprehensive review.

The technique of Inelastic Electron Tunneling Spectroscopy (IETS) for the study of vibrational modes of surface species is free from the normal selection rules other vibrational surface spectroscopies are subject to. In chapter five *N. M. D. Brown* discusses this technique where the adsorbates to be measured are introduced as dopants in the insulator component of a metal-insulator-metal tunnel junction.

Chapter six, written by *F. P. Netzer, J. A. D. Matthew* and *E. Bertel*, is devoted to exited electron spectroscopies in surface science. Whereas Auger-Electron Spectroscopy is routinely used to determine the chemical composition of surfaces, detailed information about the chemical state of the adsorbate and its adsorption site can also be determined from the Auger transitions involving valence electrons and from angular effects. Electron Energy Loss Spectroscopy (EELS) on clean and adsorbate covered surfaces, involving electronic transitions, is discussed in detail. Excellent summaries including illustrative examples are given for Electron Stimulated Ion Desorption (ESD) and Inverse Photoemission Spectroscopy (IPES).

The last two chapters of the book are devoted to vibrational surface spectroscopies, i.e. "High Resolution Electron Energy Loss Spectroscopy" (HREELS) applied to clean and adsorbate covered surfaces is reviewed by *M. A. Chesters* and *N. Sheppard*, and "Infrared Reflection-Absorption Spectroscopy (IRAS) of Adsorbed Molecules" is discussed by *A. M. Bradshaw* and *E. Schweizer*. *Chesters* and *Sheppard* make detailed comparisons of HREELS with IRAS and Raman spectroscopy and emphasize the relative merits of the techniques. This article on HREELS is an excellent introduction to this important technique. *Bradshaw* and *Schweizer* review the use of IRAS on metal and semiconductor surfaces, discuss those factors which are important in the optimization of the IRAS experiment, and compare dispersive and interferometric instruments. The examples given to demonstrate the state of the art in IRAS include hydrogen adsorption on tungsten and silicon surfaces, CO adsorption on Pt(111), K/Pt(111) and stepped platinum surfaces, and the detailed spectroscopic study of surface formate and surface methoxy species.

Like the last article, the book as a whole is not only an excellent introduction to modern techniques in surface science. The many practical hints and comments make it a valuable hand-book in materials science and surface science laboratories.

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