Structure and properties of the solid surface

The Chemical Physics of Surfaces. By S. Roy Morrison. Pp. xii+415. (Plenum: New York and London, 1977.) $47.40.

SURFACE STUDIES constitute a substantial growth area in contemporary scientific research. During the past decade or so, a host of new techniques have provided insights into the structure and properties of the solid surface. These developments in turn have had a bearing on those technologically important processes where surface interactions are important—in solid-state devices, in oxidation, in corrosion and in catalysis.

In the past four years, several small monographs have appeared on the structure of the solid surface (Oudar, Blakely, Samorjai, Prutton); in those cases where reactions have been considered, however, they have been treated largely in terms of the atomistic nature of the surface. The present book attempts to re-dress the balance by emphasising the electronic band structure of the surface and the role of surface states in determining the interaction of the surface with a gaseous or liquid environment. The book is thus aimed primarily at those interested in surface chemistry and tends to deal more with semiconductors than with other types of solid.

The author expresses the hope that the book will also appeal to the mature surface physicists but it seems to me that it is too specialised and that it lacks more figures of the type given in Figures 5.1 and 5.2, where the lobes of orbitals and so on are of particular assistance to the non-chemist, and a few more energy diagrams illustrating the electron or hole switching mechanisms would clarify some of the verbal accounts of surface interactions.

Again, the references (almost 1,000) cover mainly the period from 1970 to 1975. The book is thus essentially a concentrated review of the more important papers published over a relatively short period. As such, it is indeed a tribute to the author's encyclopaedic knowledge and understanding of recent work involving general aspects of surface interactions, especially in relation to semiconductor surfaces. It does, however, carry with it certain limitations. For example, because of Dr Morrison's overwhelming interest in catalytic processes and in the chemical properties of ionic and semiconducting solids, his account of surface interactions gives only passing reference to faceting and little more to the role of surface defects.

One of the most exciting (and perhaps depressing) features of surface science is the rate at which new techniques are continuously emerging. Dr Morrison's book deals with papers up to the end of 1975 and quotes ultraviolet photoelectron spectroscopy (UPS) as "the most important tool of the surface spectroscopies in providing us with information on surface states and adsorbate bonding". Since then, high resolution energy loss spectroscopy (HRELS) at extremely small electron energies has appeared on the scene and has shown that it is possible to detect the vibrational characteristics of adsorbed atoms or molecules. It thus promises to provide more direct information than UPS about the location and bonding of surface species. No doubt in two years' time it will be superseded by yet another technique. This is not, of course, a criticism of Dr Morrison's monograph. His book is a treasury of information and an essential acquisition for any laboratory engaged in surface studies involving catalysis and solid–gas or solid–liquid interactions, especially of semiconducting solids.

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Broad geophysical canvas

Our Changing Planet. By John Gribbin. Pp. 165. (Wildwood House: London, 1977.) £5.95.

THIS small book is intended to persuade laymen of the importance of geophysical research to Man's present needs, and also of its intrinsic interest. It ranges over a broad canvas, including the origins of the Solar System, oil, gas and metals, the possible relationship between sunspot activity, climate, biological evolution, and earthquakes, as well as the inevitable plate tectonics. This hotchpotch hangs together moderately well and avoids the doomwatch approach which often characterises such publications. The book is also well produced, with a pleasant appearance, a short layman's bibliography and an index. To complet the credit score, the number of printer's errors are few and these are amusing rather than annoying—larval plains on Mars, for example.

After commenting favourably on its readability, however, the credits become largely exhausted. The glib tone tends to be combined with an inadequate presentation, occasional misrepresentation and even straight errors. The importance of continental shelves as potential oil fields is clear enough without claiming that the Siberian Artic continental shelf is larger than Africa, and the English Channel does not immediately jump to mind as exemplifying the characteristics of the shallow seas in which oil deposits are laid down. Greek ideas on the cause of earthquakes, dismissed as silly, still seem appropriate in particular conditions, such as those at Agadir. Some arguments are seriously neglected, such as the isotopic information for the origin of the metal brines of the Red Sea, and others seem almost topsy-turvy.

Earth expansionists use the 'improved' fit of the continents on a smaller globe as part of their evidence in favour of expansion yet Gribbin sees the fit as a clear argument against. Although this reviewer's feelings about expansion make him side with Gribbin on this, the lack of evidence for expansion on the Moon, Mars, Venus, and so on, are the more telling arguments and are ignored.

It is also somewhat distressing to find, apparently, how provincial geologists are, compared with geophysicists. Apparently, geologists are concerned only with the status quo, and it is geophysicists who are concerned with the changing Earth. Although such cynical comments can be made only too easily, the most serious drawbacks for the lay reader, however, must be the lack of adequate illustrations and of clear exposition as to what, for example, plate tectonics is. If the initial picture had been presented more clearly, then one could almost, but not quite, forgive some explanations—for instance, how can North America override a spreading ridge? Simply because the Atlantic is spreading westward faster than the Pacific is spreading eastwards! In many cases, the glibness overtakes the information which is necessary, even for the lay reader. The Chandler Wobble, for example, is described as the pole dancing around, in stately fashion, relative to the stars, but the uninitiated will want to know the scale of this dance—is it confined to a barn, a ballroom or a continent?

I am sorry that I cannot recommend this book to anyone, which is not merely unfortunate but depressing. If John Gribbin had spent much longer on its preparation and confined himself to only two or three topics, it could have been excellent—but he didn't.

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