# Structure and dynamics of surfaces: phenomena, models, and methods

A. P. Silin

Usp. Fiz. Nauk **156**, 188–189 (September 1988)

*Structure and Dynamics of Surfaces II: Phenomena, Models, and Methods.*/ Eds. W. Schommers and P. von Blanckenhagen. Springer-Verlag, Berlin; Heidelberg; New York; London; Paris; Tokyo, 1987. 391 pp. (Topics in Current Physics. V. 43).

The structural and dynamic properties of surfaces play an important role in the explanation of such phenomena, for example, as adsorption of particles and chemical reactions on surfaces. Electron states utilized in tunnel diodes and in semiconductor devices in metal-insulator-semiconductor systems also depend on the structure of the surface of the semiconductor.

In the volume under review properties of ordered and disordered surfaces are examined, as are the harmonic and

 0038-5670/88/090885-02$01.80  

anharmonic surface effects. In view of the fact that on the surface of a crystal the mean squared amplitudes of particles are significantly greater than within the bulk of the crystal, the structural disordering and the anharmonic effects at the surface of a crystal are great. One should also emphasize the importance of liquid surfaces for modern problems of surface physics, chemistry, and biology.

In the first chapter (W. Schommers) the basic concepts of surface physics are introduced. Reconstruction and relaxation of a surface are examined, as well as phase transitions and surface defects, surface phonons, diffusion, adsorption and desorption, magnetism and electronic states on the surface, interfaces and superlattices. The possibility is examined of utilizing the scattering of electrons, helium atoms, neutrons and ions for the analysis of crystal surfaces.

In the second chapter (L. Miglio, G. Benedek) the standard method of Green's functions is utilized to investigate surface oscillations. The dispersion of surface phonons is calculated for crystals of the NaCl type.

Surface diffusion and the growth of a layer are investigated in the third chapter (P. von Blanckenhagen). Particular attention is devoted to experiments on the scattering of x rays, neutrons, and helium atoms. Some typical experimental results are presented on the investigation of surface diffusion, such as the study of its anisotropy and temperature dependence on metal surfaces. In the second part of this chapter methods of investigating epitaxial growth of crystals and superlattices are examined.

In the fourth chapter (E. Bauer) the two-dimensional phase transition is discussed in systems when the interaction of atoms in the surface layer is small compared with their interaction with the substrate. Both experimental methods of investigation, and the theoretical foundations of the phase transitions are presented.

The fifth chapter (J. Als-Nielsen) is devoted to the investigation of surfaces by means of synchrotron radiation.

The structure of liquid surfaces is described with the aid of distribution functions and correlation functions. These functions are investigated in the sixth chapter (W. Schommers). The single-particle distribution function is introduced for the determination of the change in density near the gas-liquid interface, and also the two-particle distribution function which is utilized to define thermodynamic functions.

In the seventh chapter (H. van Beijeren, I. Nolden) the coarsening transition, surface melting, and also the dependence of surface tension on surface orientation, and the equilibrium shape of the crystal are examined. One should note the use of statistical mechanics methods for investigating surfaces, in particular the method of the renormalization group.

The theoretical and experimental aspects of adsorption and desorption are examined in the eighth chapter (G. Doyen). The basic ideas and the interrelationship between various approximations are presented.

In the ninth chapter (A. Muramatsu, W. Hanke) a microscopic theory is presented of the elementary surface excitations, of the surface electromagnetic response, of electron-phonon interaction, and of the lattice dynamics of a surface. The conclusions of the theory are applied to the (111) surface of Si.

The book under review gives a quite complete idea concerning a number of interesting directions in surface physics which are rapidly developing at the present time. The contents of the book are of essential interest for a wide circle of theoreticians and experimenters specializing in solid state physics. The book has excellent illustrations (167 figures) and contains an extensive bibliography.

Translated by G. M. Volkoff