

Surface Mobilities on Solid Materials

Fundamental Concepts and Applications

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Surface Mobilities on Solid Materials

Fundamental Concepts and Applications

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PREFACE

The surface of solids had long been considered simply the external boundary which determined the outside appearance of the solids but had no intrinsic character of its own. The concept that surfaces have specific properties and are the first and foremost means of communication between individual things and the rest of the universe is fairly new, coming into prominence only in the early sixties.

This new concept of surface properties was the result of a vast accumulation of knowledge due to recent development of research in this area. This breakthrough of surface science resulted from the combined action of four factors: (i) control of surface sample preparation, (ii) control of the surface's environment, (iii) improvement of measurement tools and techniques, and (iv) the importance of surface properties in many new industrial areas.

Nearly eighty techniques are now available to help us answer to the following questions:

- what is the surface structure or arrangement of surface atoms?
- what are the atomic species present?
- what is the spatial distribution of foreign atoms?
- what are the nature and distribution of possible defects on the surface?
- what is the electronic structure of the surface atoms?
- what is the motion of atoms on the surface?

In general, two or more analytical techniques are used concurrently to assure unequivocal answers to problems. Different techniques employ different combinations of incident probes and the scattered or secondary particles that convey information regarding the surfaces. The latter may be photons, electrons, neutrons, ions, or phonons. Electric or magnetic fields are also used.

However, the recent successes of surface science should not blind us to the weaknesses and gaps which still exist in our knowledge of this field, a situation normal for any branch of

science still in its infancy and not yet able to grasp its full potential. Surface diffusion is a case in point. The complete characterization of a surface must consider its dynamic nature, for not only can a surface change its structure and composition with time during heat treatment and surface reactions, but in some cases the interactions of probe and sample may also lead to such changes. Moreover, in most technological applications the surface is the first and foremost site for exchanges, so that the notion of mobility plays a leading role in such problems. The lack of information on this subject is particularly serious because some new industrial areas cannot maintain their present pace of development unless the time lapse between discovery of the fundamentals of a mechanism and its applications to industrial production is extremely brief.

Such considerations and the recent progress in surface diffusion studies provided the impetus for this NATO Advanced Study Institute on Surface Mobilities on Solid Materials. The goal of this two-week meeting was to gather at a pleasant and isolated site most of the active workers in this field, in order not only to promote personal contact among the participants, but to elaborate, thorough critical reviews, on up-to-date knowledge on surface diffusion, both theoretical and experimental, and to highlight those areas in which much more knowledge needs to be accumulated. The results are reported in this book.

Because of the interconnection between subjects, the order of the review articles is more or less arbitrary. The following guideline is offered to the reader.

After the introductory article, which gives an overview essential to an understanding of the field of surface diffusion, the articles are organized into six parts:

- Part 1 deals with theoretical aspects of surface diffusion
- Part 2 deals with surface diffusion studied at the atomic level
- Part 3 deals with mass transport of foreign adsorbates
- Part 4 deals with surface self-diffusion mass transport
- Part 5 deals with the role of surface diffusion in some fundamental and applied sciences
- Part 6 dealing with recent results on surface diffusion and includes abstracts of poster and workshop presentations of recent work

The articles seek to be as complete as possible (except for two which appear only as extended abstracts), and are the "fruits of rather intensive labor" by all of the contributors, as noted by R. Gomer in his introduction. The authors are to be complimented and thanked for such contributions.

The Organizing Committee (Vu Thien Binh (Director), R. Uzan, C.H.S. Dupuy, and M. Drechsler) is particularly indebted to Dr. M. di Lullo, Director of the NATO Scientific Division, and to Dr. T. Kester, President of the International Transfer of Science and Technology, who contributed invaluable experience to setting up the Institute. The secretarial burden fell on Mrs. D. Debaere and Miss J. Bullock, who throughout the Institute worked expertly and smilingly. We are much indebted to Mr. J. Chanel and Mr. D. Guillot, who fulfilled many technical responsibilities with great skill, and we acknowledge the continuous help of Dr. J. Lopez.

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Vu Thien Binh

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