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Major achievements and Development directions in surface physics and surface chemistry

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Abstract

This paper mainly introduces the major achievements and development directions in surface physics and surface chemistry, and some relevant knowledge of surface physics and surface chemistry are described in detail.

Keywords

Surface Physics, Surface Chemistry, Achievement, Development .

1. Introduction

The surface interface is a transition region between phases in a multiphase system. From the definition of the table interface, it can be seen that the object of the table interface study is the heterogeneous heterogeneous system, or more specifically, the transition region from one phase to another in the heterogeneous system. The surface and interface are two-dimensional regions where the physical and chemical properties of materials change dramatically in space. Many important physical and chemical processes of materials first occur on the surface, and many damages and failures of materials first originate from the surface and interface. Therefore, the study of the microstructure of the surface and interface and its interaction with the external environment is crucial to the control of the physical and chemical processes on the surface of materials and the change of the surface properties of materials. The surface is the window through which the material is directly connected with the external environment. The purpose of changing the material properties can be achieved by studying various physical and chemical processes of the material surface interface. In the past 10 years, material surface science has played a key role in promoting the basic research of material science and the development of new materials and technologies. At the turn of the century and even in the next century, surface science will face new challenges and opportunities. On the one hand, it comes from the needs of industrial and technological revolution, and on the other hand, it comes from the impetus of scientific development[1].

2. Major achievements in surface physics and surface chemistry

2.1. Achievements of surface chemistry

The main achievements of surface chemistry are reflected in three aspects, including the adsorption and desorption of hydrogen on the surface, the surface catalytic process, and the space-time self-organization phenomenon of solid surface reactions. With regard to the adsorption and desorption of hydrogen on the surface, important progress has been made in the study of the desorption process of hydrogen molecule (H2) on Si(100) surface through theoretical calculation and experimental observation. The first principle molecular dynamics method is used to simulate the process of hydrogen molecule group interaction on the surface. At the same time, a clear image of the adsorption and desorption process of hydrogen molecules

on Si(100) surface was obtained by using STM method. For surface catalytic processes, Stampfl and Scheffler used density functional theory to calculate the surface energy and chemical reaction pathways of carbon monoxide (CO) on the surface of Ru(0001). For solid surface reaction self-organization phenomena of space and time, Gerhard and others with light emission electron microscope (PEEM) of carbon monoxide in the atmosphere composition distribution were observed on the surface of the metal platinum, under the condition of different temperature and pressure, form all sorts of design of platinum surface density distribution, oxygen content and at a certain time interval extension along a certain direction[2].

2.2. New achievements of surface science in analytical techniques and industrial applications

In the field of application, first of all, in terms of crystal structure and chemical composition analysis, auger photoelectron spectroscopy, surface analysis system, secondary ion mass spectrum and polarization tester and surface analysis techniques have been widely applied in industry, in addition, scanning tunneling microscopy, surface optical analysis system, and equipped with electron energy loss spectrum of atomic resolution transmission electron microscopy (sem) and reflection high energy electron diffraction spectrum is also accepted by the industry. In recent years, synchrotron radiation combined with surface technology has also been successfully developed in medicine and biology. In the preparation of thin film materials, various modern methods developed by surface technology, such as molecular beam epitaxy, chemical vapor deposition, sputtering and laser stripping growth, have been able to obtain a variety of artificial multilayer film structures by controlling the stress, composition and doping conditions. Recently developed microelectromechanical systems based on surface science and nanotechnology are attracting increasing attention, and a variety of micro-sensors, drives, controllers, and data storage for industrial applications have been developed. In the field of surface micromachining, etching technology, plasma source ion implantation technology and atomic force tunneling microscope assisted plate making technology have been successfully used to prepare semiconductor devices[3].

2.3. New achievements in scanning probe technology (SPM) and surface science

Scanning probe techniques by the end of the century the advent of science and technology on the surface of a landmark in the field of important achievements, it brings people to the understanding of the material surface physical and chemical process and control into the atomic scale level, the emergence of this technology, greatly promote the development of surface science, and then a series of important research results. The achievements in this field mainly include direct observation of surface charge density wave, determination of Si surface atomic structure, single-atom manipulation and movement of single-molecule devices and surface atoms. In terms of direct observation of surface charge density wave, STM technology is used to observe the surface charge density wave in a-pb/Ge(111) system for the first time. In terms of determining the atomic structure of Si surface, direct observation of Si surface structure and defects was realized by using the scanning tunneling microscope (STM), and the surface structure of Si was determined by combining with LEED and theoretical calculation. In terms of single atom manipulation and single molecular devices, people have been able to move single atoms and molecules in the solid surface, on a single chemical bond shear, so far has constructed many kinds of artificial atomic structure and single molecular devices, and the surface of the single atom manipulation process involved in research in physics and chemistry problems. In terms of the motion of surface atoms, it is mainly manifested in the interaction between soliton chemical wave and surface, the observation of surface reaction fluctuation and the research results of tracking the diffusion motion of surface atoms[4].

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3. Development direction of surface physics and surface chemistry

3.1. Development direction of surface physics

So far, important progress has been made in the study of surface physics. Experimental and theoretical methods have been developed to effectively determine the surface structure and study the electronic states on the surface. However, for the complex, incomplete, especially close to the actual surface, both experimental research methods and theoretical understanding have yet to be developed. In addition to the properties of the ground state and the equilibrium state, the scattering and kinetic properties of the surface are almost blank. The research on the latter two aspects will greatly deepen the understanding of surface physical processes, and at the same time help surface physics to play its role more widely and effectively, and promote the development of science and technology[5].

3.2. Development direction of surface chemistry

Due to surface chemical reaction research is relatively difficult, should make full use of the existing theory, through reasonable assumption, established a relatively perfect mathematical model, through computer molecular simulation, a lot of work study, and then use the advanced instruments, such as atomic force microscopy, transmission electron microscopy, high-resolution transmission electron microscopy, electron diffraction, X-ray diffraction and microscopic image analyzer, femtosecond laser technology to realize the online experiment in situ, observed on the surface of atomic and molecular dynamics. As human research continues to dig deeper into the macroscopic and microscopic poles, there is a new frontier in the so-called mesoscopic realm between the macroscopic and microscopic worlds. At present, there are many researches on its products and technologies, but there is still a lack of in-depth and systematic research on its scientific laws. The "pressure gap" and "material gap" between surface chemistry research and actual systems still exist. The vitality of surface science lies in its intersection and integration with other disciplines. It provides a variety of analytical techniques and methods to help people understand and illustrate the basic scientific problems encountered in related disciplines at the molecular and atomic levels.

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