2.5.

ABSTRACTS OF THE LECTURES

to be held on the

THIRD INTERNATIONAL SUMMER SCHOOL

ON VACUUM PHYSICS

(3. ISSVP)

September 26 - October 1, 1977

Fonyód, Lake Balaton

Hungary

A-II. 4. Mizsei, J. and G. Bajor (Budapest)
Electrical properties of ion etched silicon surfaces

A-II. 5. Soszka, W. (Warsaw)
Ion-forwarded electron spectroscopy

B. SURFACE AND MOLECULAR PROCESSES AT LOW PRESSURES

B-I. Invited lectures

B-I. 1. Degras, D. A. (Saclay)
Mechanisms of surface reactions

B-I. 2. Giber, J. (Budapest)
Problems of the quantitative SIMS analyses

B-I. 3. Kapuy, E. (Budapest)
Quantum theory of chemical reactions

B-I. 4. Kurepa, M. V. (Beograd)
Recent developments in ionization processes in gases

B-I. 5. Viehböck, F. P. (Wien)
Detection of neutral and metastable particle beams

B-II. Contributed lectures

B-II. 1. Csanády-Bodoky, Á., Á. Barna and P. B. Barna (Budapest)
Investigations of gas-surface interactions on thin metal layers by in situ electron microscopy

B-II. 2. Füstöss, L. (Budapest)
The role of the interaction between gas atoms and surface at molecular flows

B-I. 4. KUREPA, M. V. (Beograd)

Recent developments in ionization processes in gases

(Invited lecture)

Two topics of recent efforts to investigate ionization processes in gases will be covered in the lecture: (a) the so called post collisional interaction, and (b) theoretical calculation of ionization cross sections.

For incident electrons of energies close to double electron excitation thresholds followed by autoionization or to thresholds for inner electron shell ionization, the interactions of two electrons, the incident and the ejected ones, were observed and measured. Within the field of the remaining ion these electrons interchange their energies. The consequence is that both of them change their initial kinetic energies in the amount which depends on the surplus of the incident electron energy over threshold energy. Recent experiments and interpretations of these phenomena will be discussed.

The ionization cross section has been determined so far only for a very limited number of elements in the periodic system. The growing need for data of this sort in various fields of science, such as astrophysics, plasma physics and thermonuclear fusion, stimulated experimentalists and theorists to concentrate on these problems. Theoretical approaches in the development of suitable techniques for ionization cross section calculation will be given and their results compared with existing experimental data.

2 4.

RECENT INVESTIGATIONS OF

IONIZATION PROCESSES IN ATOMS

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ABSTRACT

For incident electrons of energies slightly greater than the double electron excitation thresholds followed by autoionization or thresholds for inner-shell ionization, the interactions of two electrons, the scattered and the ejected one, were observed and measured. These electrons interchange their energies within the field of the remaining ion. As a consequence both of them change their initial kinetic energies by an amount dependent on the surplus of the incident electron energy over the threshold energy. Recent experiments and interpretations of these phenomena will be discussed.

1. INTRODUCTION

In this lecture I wish to describe a group of processes detected very recently in collisions of electrons, ions and photons with atoms, leading to formation of singly or multiply charged ions.

When talking of the scattered, ejected or Auger electron energies, we usually take what might be called the traditional approach which is traditional in a sense that we suppose, for instance that, if the electron is inelastically scattered by an atom, the kinetic energy it is carrying away is always equal to the difference between its incident energy and the energy transfered to the atom. This picture is correct for most of the energy transfer reactions. However, there is a group of them in which the process is not completed by the transfer of energy from the incident particle to the target atom. The inelastically scattered or ejected electron can have very small velocity and remain in the vicinity of the excited atom or ion for a comparatively long time. During this time the excited atom or ion is still within the range of the Coulomb force of the receding electron, and any sudden change within the system, such as ejection of one atomic electron will be experienced by the receding electron. Thus, the interaction between the scattered electron and the rest of the system continues, and necessarily leads to further changes in the system. If one arbitrarily takes the primary transfer of energy as the instance of the collision, this additional interaction may be called the "post collisional interaction".

Experimental evidence of changes in the system following a sudden event, started to appear recently. I am going to present here the main and the most interesting of these results, as well as the theoretical attempts to interpret and explain the experimental data.

2. EXPERIMENTAL EVIDENCES OF INTERACTION BETWEEN TWO ELECTRONS IN AUTOIONIZATION AND AUGER ELECTRON EJECTION PROCESSES

2.1. Displacement of scattered and ejected electron energies in excitation of autoionizing levels

The first experimental evidence of the existence of an unknown process in excitation of autoionization states has been obtained in ion-atom collisions by Barker and Berry (1966). Further systematic study of this phenomenon was started a few years later, mainly by electrons incident on atoms.

An electron spectrometer of the kind used for ejected electron analysis is shown shematically in Fig. 1. A high intensity electron beam is crossed at 90^{o} with a beam of He atom. Electrons scattered by and/or ejected from atoms are energy selected by a hemispherical analyzer, with a resolution better than 50 meV. The analyzer can be rotated relative to the primary electron beam direction about the atomic beam axis. The target is excited by low energy electrons in order that

4. SUMMARY

The energy displacement of scattered, ejected and Auger electrons above the respective thresholds have been studied so far for a very limited number of atoms, and for a limited choise of incident electron, or photon, energies. For the understanding of these processes, farther experiments are needed. This applies in particular to the angular analysis of electrons ejected from autoionizing states and Auger electrons. Results of this kind are needed to establish the behaviours of interference effects. A greater number of data would stimulate the theoretical approaches to explain the experimental results.

At the time being one can not give a deffinite ansver whether the semiclassical approach of Niehaus and collegues, with the proposed total coherence of states, or the quantal approach of Read, with a partial coherence of states, gives better interpretation of processes involved. It is obvious that there is a lack of a thorough quantal calculation. The first attempt of this kind by Bottcher and Schneider (1976) in incuraging, but certainly still not properly elaborated to interpret and explain the limited amount of collected experimental facts.

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