20th Summer School and International
Symposium on the Physics of Ionized Gases

20th SPIG

September 4 - 8, 2000, Zlatibor, Yugoslavia

CONTRIBUTED PAPERS

&

ABSTRACTS OF INVITED LECTURES, TOPICAL INVITED LECTURES AND PROGRESS REPORTS

Editors:
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PREFACE

This book contains the Contributed papers and abstracts of the Invited lectures, Topical invited lectures and Progress reports to be presented at the 20th Summer School and International Symposium on the Physics of Ionized Gases – SPIG 2000. The Symposium will be held in Zlatibor, Yugoslavia, from September the 4th to September the 8th, 2000.

The Contributed papers are related to the following research fields: Atomic Collision Processes, Particle and Laser Beam Interaction with Solids, Low Temperature Plasmas and General Plasmas. The length of a Contributed papers is limited to a maximum of four pages, each of them presenting an original work with sufficient amount of scientific information.

The Scientific and Organizing Committees believe that this Symposium, with its Invited lectures and Contributed papers, managed to maintain the high scientific level established by previous SPIG conferences in the 40 years long tradition. To mark the occasion of the 20th SPIG a special, *fifth*, section was introduced dealing with the history of SPIG. A separate session will be arranged with a lecture on the history of SPIG. All the participants, especially those that took part in early SPIG conferences are invited to share their memories, impressions and thoughts on the future of the conference.

The Organizers of the 20th SPIG are the Institute of Physics, Faculty of Physics – University of Belgrade and Institute of Nuclear Science "Vinča". The Organizer gratefully acknowledges the support of the Ministry of Science and Technology of the Republic of Serbia and Ministry of the Development, Science and Environment of the Federal Republic of Yugoslavia. We also acknowledge support of PTT Serbia and Jumko. The Organizing committee appreciates the help from the previous Organizers, Mr. I. Videnović in particular.

The participants have been asked to send their papers camera ready, so no typing, spelling and grammatical errors have been corrected in the course of preparation of this book.

June, 2000. Editors

DIFFERENTIAL CROSS SECTION MINIMA IN ELECTRON SCATTERING BY ZINC ATOMS

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Abstract. Differential cross section (DCS) measurements were performed for both elastic and inelastic (excitation and autoionization) scattering of electrons by zinc atoms. Angular positions of DCS minima were determined in the impact energy range from 10 to 40 eV and scattering angles from 8.5 to 150°. Results are compared with available experimental and theoretical data.

1. INTRODUCTION

As a continuation of our previous e/Cd [1] and e/Hg [2] differential cross section (DCS) measurements, our work on zinc is presented here. So, we complete the investigation of the IIb group of Periodic table of elements. Lower angle DCS minimum is traditionally of interest in interpretation of a cross section through the effective atomic diameter, if the electron diffraction by target atoms is predominant phenomenon. Also, DCS minima are important because they are a sensitive test of the validity of both experimental procedure and theoretical predictions.

To our best knowledge, there are no recent experimental data of DCS's for elastic or inelastic (excitation) electron scattering on Zn, except those by Williams and Bozinis [3], at 40 eV incident electron energy. Only Traimar and Williams [4] reported energy-loss spectra for autoionising levels in Zn, at 20 and 40 eV.

2. EXPERIMENTAL

The electron-impact spectrometer used for the present measurements has been described in detail elsewhere [5]. We utilized a crossed beam technique: a monoenergetic electron beam crosses a beam of Zn atoms at right angle; the scattered electrons being energy analyzed and detected at scattering angles θ, with respect to the incident electron beam direction. To

produce Zn-vapor [6] we have used titanium oven containing of 99.9% purity Zn, heated by coaxial heaters. The temperatures were between 670 and 720 K, what was below a critical value for the double scattering appearance. The overall energy resolution of about 100 meV was enough to resolve all prominent peaks in the energy loss spectra. A difference between instrumental and real zero scattering angles was estimated to be within ±0.5°. The angular resolution in the present measurements was 1.5°.

3. RESULTS AND DISCUSSION

We have measured DCS's for elastic scattering of electrons at 10, 15, 20, 25 and 40 eV impact energies, and scattering angles from 20 to 150°. Three DCS minima are observed for elastic scattering. Lower angle minimum appears for all the numbered energies. Middle angle minimum appears at 20 eV and higher impact energies. We observed higher angle minimum

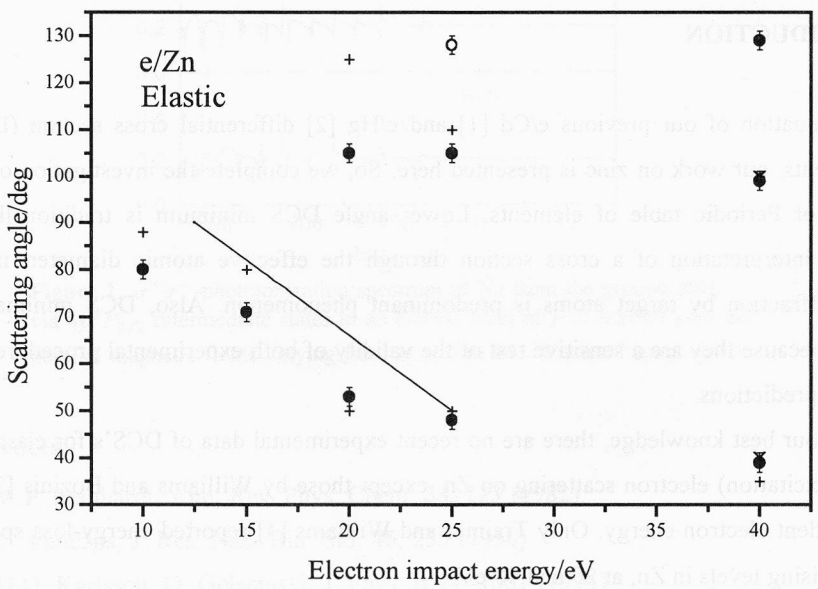

Figure 1. Positions of DCS minima in elastic electron scattering by zinc: •, present; ×, Williams and Bozinis [3]; +, Childs and Massey [7]; —, McGarrah *et al* [8]. Open circle, ○, denotes inflecton point of the higher angle minimum observed in our measurements.

only at 40 eV impact energy. The minima positions obtained in this work are presented in fig.1, together with other available experimental and theoretical results [3,7,8].

At 10 and 15 eV impact energies we found the lower angle DCS minima at 80 and 71°, respectively. Calculations by McGarrah *et al* [8] predict the lower DCS minimum close to 90° in both cases. Agreement with experimental results by Childs and Massey [7] is better, but their DCS minima are shallow. At 20 eV we found the lower angle minimum at 53° and also the middle angle DCS minimum at 105°. Agreement with the results by Childs and Massey [7] (only available at 20 eV) is much better in the case of lower than in the case of middle angle minimum. At 25 eV our results for lower angle (48°) and middle angle (105°) minimum show good agreement with results obtained by others [7,8]. At the same energy inflection point at 128° is evident in our DCS, contrary to a local DCS maximum obtained by Childs and Massey [7]. We have determined three minima at 40 eV impact energy: lower angle at 39° and middle angle at 99° (in good agreement with others), as well as the higher angle DCS minimum at 129° found only in our measurements.

We have measured DCS's for inelastic electron scattering at 10, 15, 20, 25 and 40 eV

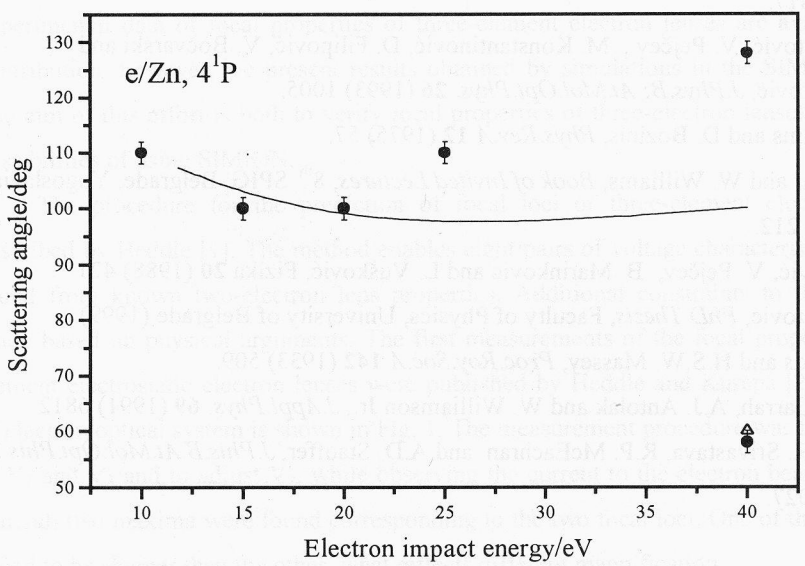

Figure 2. Position of DCS minima in inelastic (4^1P) electron scattering by zinc: •, present; —, Kaur *et al* higher angle minima [9]; Δ, Kaur *et al* lower angle minimum [9].

and scattering angles from 8.5 to 150°. The 4^3P, 4^1P, 5^1S, 5^1P and 6^1P states have been observed. Two DCS minima, observed for inelastic 4^1P electron scattering by zinc, are presented in fig. 2. Higher angle minimum appears for all the numbered energies. Lower angle minimum appears only at 40 eV impact energy. Positions of DCS minima from our measurements are in good agreement with theoretical calculations by Kaur *et al* [9], except for lower angle minimum at 40 eV impact energy. Our DCS results show deeper minima than that of the theoretical calculation. Experimental errors, as well as autoionization process, will be discussed at the conference.

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