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ELECTRON INTERACTIONS WITH ZINC ATOM

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Introduction

Electron scattering by atoms of the IIb group of the Periodic System of Elements has been the main subject of our interest. We measured differential cross sections (DCSs) for electron impact on cadmium atom (1) and mercury atom (2), whereas now we work on the zinc atom, which happen to be the least investigated.

Experimental

Our experiment is of the crossed-beam type and it has been described elsewhere (1,2). For this particular purpose we have constructed a new oven in order to attain higher ultimate temperatures and a better temperature control. The crucible is made of titanium (3) which is completely resistive to zinc vapour and is placed into the stainless steel cylinder which bears two heaters - one at the top and the other at the lower half, thus providing the temperature difference of about 100 °C. We used a titanium foil to make a reflective shield around the oven and at its top end. Temperature monitoring was carried out by two thermocouples, at the bottom and on the top of the crucible.

Results and Discussion

To our knowledge, there are no recent experimental data of differential cross sections for either elastic or inelastic electron scattering on Zn except those given by Williams and Bozinis (1978) (4) who measured DCSs for the elastic scattering and for the excitation of four states, at 40eV incident electron energy. On the other hand, there are only two recent theoretical papers concerning electron - Zn atom scattering; the first by McGarrah *et al* (1991) (5) who calculated elastic differential and total cross sections, from 12.5 to 200 eV, and second by Kaur *et al* (1997) (6), who calculated DCSs, Sherman functions and Stokes parameters for three incident electron energies (10, 20 and 40 eV) for the first four excited states. Our experiment should throw more light on the nature of these processes.

In order to estimate the overall energy resolution and to make sure that there are no multiple collisions in the interaction region, we took down the energy-loss (ΔE) spectrum. In Figure1 is shown the energy-loss spectrum for the E_o=40 eV incident electrons, scattered at θ=4°. The working pressure was of the order of 10^{-4} Pa and the oven temperature (at the bottom) 380°C. Since the states

of zinc are well separated, it was not necessary to insist on obtaining the best possible energy resolution. In the case of this spectrum, it was about 200 meV.

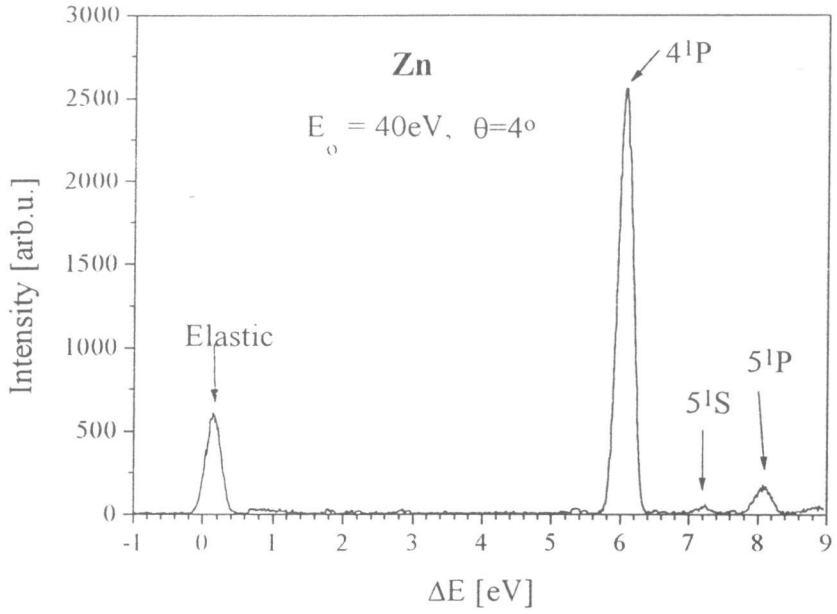

Figure 1: Energy-loss spectrum for electron-Zn atom scattering

Our aim is to measure differential cross sections for electrons of different incident energies, from 20 to 100 eV, scattered at angles ranging from 20 to 150°. It is obvious from Figure 1 that the most dominant process at small angles is the excitation of the 4^1P state of Zn. The other states have much less probability for excitation. It is the same with elastic scattering.

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Apstrakt

Na elektronskom spektrometru ESMA, koji radi na principu ukrštenih mlazeva projektila i mete, merena je ugaona raspodela elektrona rasejanih elastično i neelastično na atomima cinka. Energija upadnih elektrona je bila od 20 do 100 eV, a opseg uglova na kojima se mogu detektovati rasejani elektroni od 20 do 150°. Izvor atoma cinka je peć za metale, čiji se rezervoar greje pomoću dva nezavisna grejača, na gornjoj i donjoj polovini visine tela peći. Tipična temperatura dna rezervoara je bila 380°C. Snimljen je spektar gubitaka energije na malom uglu (θ=4°) i uočeno je da je najintenzivnije pobudjenje rezonantnog stanja cinka, 4^1P, mnogo verovatnije nego elastično rasejanje ili pobudjenje ostalih stanja, 4^3P, 5^1S i 5^1P.

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