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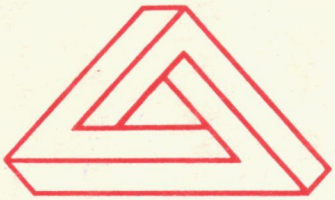

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DIFFERENTIAL CROSS SECTIONS FOR THE ELASTIC ELECTRON SCATTERING BY SODIUM ATOM

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Introduction: Many experimental and theoretical investigations have been performed on electron scattering by sodium vapour. Differential cross sections (DCS) serve as an sensitive test for the validity of theoretical description of the scattering process. Still, the discrepancies exist between different experimental data[1-4], different calculations[5,6] as well as comparing experiment and theory. Recently, the large discrepancies were reported[5] between theory and experiment for the DCS at backward angles.

Relative DCS for the elastic electron scattering by sodium atom have been obtained for 5, 10, 20 and 54.4 eV impact energies and from 6^0 to 150^0scattering angles.

Apparatus: The apparatus described in more details elsewhere[7] consists of hemispherical electron monochromator producing well collimated electron beam and an independently rotatable energy analyzer of scattered electrons. Inicident electron beam and initaial direction of analyzed electrons define the scattering plane perpendicular to the atomic beam. The electron gun uses a hairpin tungsten cathode and produces monoenergetic electron beam of 1 to 10 nA. The energy analyzer consists of zoom lens, hemispherical selector and accelerating lens and can cover the angular range from -30^0 to $+ 150^0$.

An atomic beam has been produced in a wire heating oven with sodium ampulla. Sodium metal was prepurified in vacuum in order to remove petroleum and then it was filled in glass ampullas. The standard working temperature of the oven was about 600 K corresponding to 5 Pa vapour preasure.

Experimental procedure: The spectrometer is used in the energy-loss mode. The incident electron beam was first collimated at the center of the interaction region and then zero scattering angle was determined utilizing symmetrical count--rates at positive and negative scattering angles. The analyzer was set to accept elastically scattered electrons. Elastically scattered electrons were observed in the angular range of 6^0 to 150^0. The background counts were substracted from signal although it was insignificance at angles larger then 10^0. Different sets of data were obtained for three distances of the interaction region: 1.5, 2 and 3 mm. This procedure was done to check if there were some irregularities in shape of atomic beam, but there was no evidence of any difference in shape of DCS. Also, temperature dependence was investigated to eliminate the presence of Na dimers or double scattering.

Results: The obtained relative DCS were normalized at 10^0 scattering angle as an average mean value from several independent measurements. Statistical error of each curve at the pariticular scattering angle was used as a ponder for average mean value. The corrections for a effective path lenght[8] were done due to variable interaction volume with the scattering angle.

The absolute scale was obtained from the elastic to inelastic (3^2P) intensity ratios on the energy loss spectra at particular angle. Extrapolating results to 0^0 and 180^0 sacttering angles and integrating with the ponders sin Ø and sin Ø (1 - cos Ø) where Ø denotes scattering angle, integral elasitic cross sections and momentum transfer cross sections were obtained. Statistical errors in these elastic scattering experiments were always within 10% in individual measurements. A contribution to the systematic error due to the unsertainty of the energy, angular scale, applied geometrical correction factor, normalization and extrapolation was estimated separetely.
The comparison of our results with the other available data indicates satisferctory agreement with the previous experiments.

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