ELECTRON EMISSION AT BACKWARD ANGLES FROM He2+, He+ (2 MeV) → He, Ne, Ar COLLISION SYSTEMS

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ELECTRON EMISSION AT BACKWARD ANGLES FROM He^{2+}, He^{+} (2 MeV) → He,Ne,Ar COLLISION SYSTEMS[(1)]

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Abstract. - Absolute double differential cross sections for projectile electron loss were measured in collision of He^{+} (0.5MeV/amu) with He,Ne,Ar targets at backward electron emission angles (90°-170°). The experimental results are compared with the theoretical values calculated on the basis of the electron impact approximation.

INTRODUCTION

A number of papers have been published on the so called electron loss process where the projectile carries electrons and it is ionized in the collision. Most of them studied the electrons ejected into forward direction relative to the beam direction finding rather good agreement between the theoretical values and experimental data. At backward angles rather few experimental and theoretical data can be found and they shows a remarkable discrepancy. Up till now the electron loss peak was not studied for different targets.

Recently, after finishing our measurement Hartley and Walters [1] published a detailed theoretical work on the electron loss process where their values were compared with the existing experimental data(in [1] references can be found for the earlier experimental and theoretical studies).

Some years ago we studied the electron loss peak for 0.8 MeV/amu He^{+}-Ar collision in the whole angular region (0°-180°) [2]. Due to the above described discrepancies at backward angles in the present work we investigated the electron loss process in this angular region for 0.5 MeV/amu He^{+}-He,Ne,Ar collision. The experimental data were compared with theoretical ones.

EXPERIMENTAL

The He^{+} projectiles were accelerated by the 5 MV VdG of ATOMKI. The He^{2+} projectiles which were also used in this study for correction (see later), were prepared from He^{+} by using a gas stripper.

The electrons ejected from the collision into the backward angles (90°-170°) were measured by a distorted field cylindrical mirror electron spectrometer named ESA-13 made in the Institute. The experimental apparatus was similar to that which was used in our earlier work [3]. The only differences was the use of three detectors

(1) Supported by DFG/Bonn and MTA/Budapest

to measure the electron spectrum at three different angles simultaneously. A pressure controlled gas beam was used as target.

The electron spectrometer was calibrated for the efficiency in function of the electron energy and ejection angle with the absolute DDCS data of Stolterfoht published for 0.5 MeV H^+-He [4] and H^+-Ar [5] collision.

DATA EVALUATION

The electron spectra measured for He^+ and He^{2+} projectiles were corrected for the spectrometer efficiency and the background counts (the electron spectra measured without gas target was subtracted). For studying the electron loss peak for He^+ projectile the "continuous background" originated from target ionization had to be subtracted. This continuous spectrum was prepared from the electron spectra measured for He^{2+} projectile which was multiplied by an energy dependent screening factor. In this way we could simulate the target electron spectra produced by He^+.

THEORETICAL

The electron loss absolute double differential cross sections were calculated in the frame of an electron impact approximation according to Jakubassa [6]. Here the incoming bound electron acts as quasi-free in the target field and weighted by the initial momentum distribution.

The values were compared with a PWBA calculation which was similar to our earlier ones [2].

RESULTS

The figure show the experimental data and the theoretical values for electron loss cross sections at He^+-He, Ne, Ar collisions. For He target the agreement is rather good within the limits of the experimental errors. For Ne target the absolute values agrees around 90^o but higher angles the experimental data increase more rapidly than the theoretical values. For Ar target the situation is similar but the experimantal data do not show such strong shell effect as it was calculated.

Not only the absolute cross sections but their patterns strongly depend on the target as it is clearly seen. For He target the cross section slowly decrease at larger angles while for Ar target a definite increase is found. The cross sections for Ne target somewhat similar to the Ar target but they do not increase more slowly.

Hartley and Walters [1] calculated the absolute SDCS for our earlier case (0.8 MeV/amu He^+-Ar [2]). Here both the theory and the experiment show a similar behavior as the presents result. However, even here the experimental values much greater than the theoretical ones. The differences are greater than those in the present case.

The evalutation of the data for the EL peak position as well as for the width (FWHM) of it as a function of the angles is also underway now on the basis of the present measurements. This suggests that the theoretical approximation calculated by us give better agreement with the experimental values than the PWBA, but even this is not perfect at the greatest backward angles.

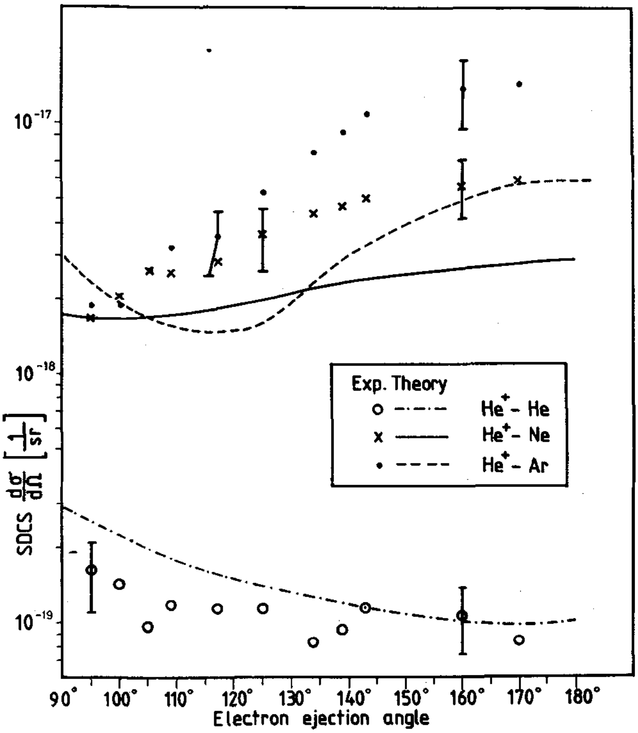

Fig. - Theoretical and experimental electron loss absolute SDCS for He^{+}-He, Ne, Ar collision at backward angles.

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