ABSOLUTE DIFFERENTIAL CROSS SECTIONS FOR ELECTRON SCATTERING IN NITROGEN IN THE ANGULAR RANGE FROM 120^0 TO 180^0

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Absolute differential cross sections for elastic electron scattering and vibrational excitation in nitrogen have been measured in the scattering angle range from 120^0 to 180^0 at the energies of 5, 6 and 7 eV. In the measurements the newly developed *magnetic angle-changing* technique [1,2] has been employed which allowed observation of electron scattering in the region of high scattering angles up to 180^0. Our results combined with the existing experimental data for lower angles give differential cross sections over a wide angular range from close to zero to 180^0. The experimental data are compared with the results of several theoretical calculations.

1. Introduction

The studies of electron scattering by nitrogen especially in the low-energy region give valuable information to develop an accurate description of electron-molecule interaction. A detailed comparison of the results of theoretical investigations e.g. integral and differential cross sections with the results of experimental measurements is important in the studies of elastic electron scattering to adequately account for the short- and long-range correlation (polarization) and exchange interactions. In the past several measurements of the elastic [3-6] and vibrational [3,10] differential cross sections have been performed. However these were done for scattering angles below 130^0 and it is now important to extend these measurements to scattering angles up to 180^0.

In our communication we present absolute differential cross sections for elastic electron scattering and vibrational (v=0→1) excitation in nitrogen at the energies of 5, 6 and 7eV measured in the range of scattering angle from 120^0 to 180^0.

2. Experimental and results

The apparatus used to obtain the differential cross sections in nitrogen consists of a hemispherical electron monochromator and an electron analyzer for the selection of incident and scattered electrons respectively and of a system of solenoids to produce the localised magnetic field in the scattering region (Fig.1). The trajectories shown in Fig. 1 correspond to the incident electron beam moving towards scattering region and electrons scattered elastically in the forward (0^0) and backward (180^0) directions.

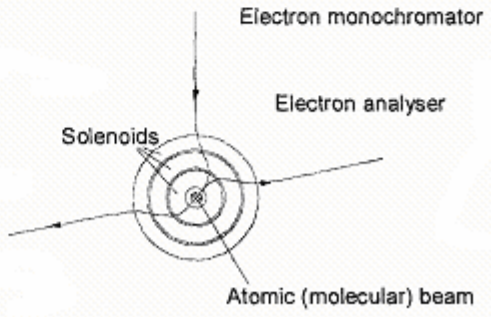

Fig.1. Schematic diagram of the apparatus used in measurements of differential cross sections in nitrogen.

The absolute differential cross sections for elastic scattering have been measured using the relative flow technique with helium as a reference gas. The cross sections for vibrational excitation v=0→1 of nitrogen have been determined from ratios of the vibrational to elastic cross sections obtained from energy loss spectra measured at fixed scattering angles.

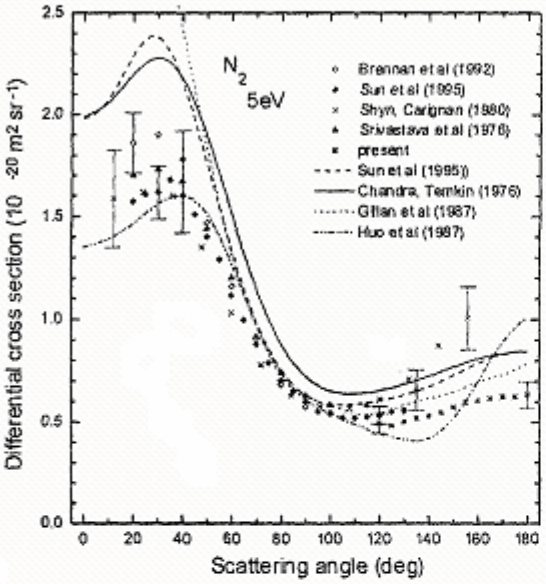

Fig. 2. Differential cross sections for elastic electron scattering at an incident energy of 5 eV

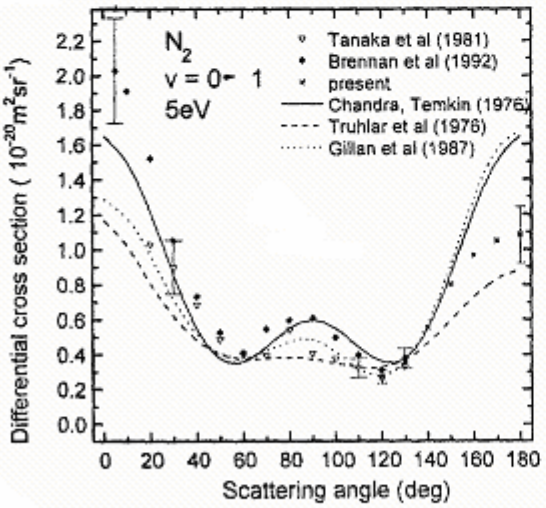

Fig. 3. Differential cross section for vibrational v=0→1 excitation in nitrogen at incident electron energy of 5 eV.

The cross section for elastic electron scattering obtained at 5 eV is shown in Fig. 2 together with existing experimental data obtained at lower scattering angles and theoretical calculations of Sun *et al* [4], Chandra and Temkin [7], Gillan *et al* [8] and Huo *et al* [9]. There is a reasonably good agreement within the experimental error of 10% with the results of Sun *et al* [4] and Brennan *et al* [3] in the region of the overlap of the data 120-130^0. Our results indicate smooth increase of the cross section with the increase of the scattering angle towards 180^0 in excellent agreement with the hybrid calculations of Chandra and Temkin [7].

The cross section obtained for vibrational v = 0→1 excitation at 5eV is shown in Fig. 3. Here we have obtained good agreement with the results of Brennan *et al.* [3] at 120^0 and 130^0. Our results together with the lower angle measurements of Brennan *et al.* [3] show that the angular distribution of the cross section at 5eV is asymmetric with respect to 90^0 unlike the prediction of the calculations of Chandra and Temkin [7] and Gillan *et al* [8].

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АБСОЛЮТНІ ДИФЕРЕНЦІАЛЬНІ ПЕРЕРІЗИ РОЗСІЮВАННЯ ЕЛЕКТРОНІВ В АЗОТІ В ІНТЕРВАЛІ КУТІВ ВІД 120^0 ДО 180^0

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Виміряно абсолютні диференціальні перерізи пружного розсіювання електронів та коливного збудження в азоті в інтервалі кутів розсіювання від 120^0 до 180^0 при енергіях 5, 6 і 7 eV. При вимірюваннях застосовано новий метод магнітної зміни кута, який дозволив спостергігати розсіювання електронів в області великих кутів розсіювання аж до 180^0. Поєднання наших результатів з існуючими експериментальними даними для менших кутів дає диференціальні перерізи в широкому інтервалі кутів майже від нуля до 180^0. Експериментальні дані порівнюються з результатами теоретичних розрахунків.