Relative differential cross sections for elastic electron scattering by furan

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Relative differential cross sections for elastic electron scattering from gaseous furan (C_4H_4O) have been determined both experimentally and theoretically. The measurements were performed using a cross beam technique, for the incident energies of 50, 75 and 100 eV and scattering angles from 20º to 110º. The calculations are based on a corrected form of the independent-atom method, known as the SCAR (Screen Corrected Additivity Rule) procedure.

Furan is the simplest five-membered heterocycle molecule and it may serve as a prototype of furanose units in biomolecules. The work of Boudaiffa et al. [1] has shown that secondary low-energy electrons can cause significant, energy-dependent single and double-strand breaks in DNA. Thus, the investigation of electron interaction with molecules that are analogue to DNA building blocks may be important for radiation damage research [2-5]. Very recently, Khakoo et al. [6] have published both experimental and theoretical results on low energy (≤ 50 eV) elastic electron scattering from furan molecule. Also, Szmytkowski et al. [7] measured the total cross section over energies from 0.6 eV to 400 eV using a linear electron transmission method and calculated integral elastic and ionization cross sections up to 4 keV. Electron collisions with furan have been theoretically investigated by Bettega and Limma [8], as well. In the present contribution, preliminary relative differential cross sections (DCSs) for elastic electron scattering from furan molecule are presented at 50, 75 and 100 eV.

Our experimental apparatus has been described in previous papers [3,9]. The experimental set-up consists of an electron gun, a double cylindrical mirror energy analyzer and a channel electron multiplier as detector. The base pressure was about 4×10^{-7} mbar, while the working pressure was in the range $(2\text{-}5)\times10^{-6}$ mbar. The electron gun, with hairpin electron source produces non monohromated electron beam that is crossed perpendicularly by the molecular beam, obtained by stainless steel needle. The electron gun can be rotated around the needle in the angular range from about -40° to 120°. The best energy resolution is limited by termal spread of primary electrons to about 0.5 eV. The angular resolution is better than ±2° [9].

Present calculations of cross sections are based on a corrected form of the IAM (Independent Atom Method), known as the SCAR (Sreen Corrected Additivitty Rule) procedure, with an improved quasifree absorption model potential, which includes relativistic and many body effects, as well as inelastic processes [10,11]. The role of the SCAR corrections to the standard IAM procedure is reducing the values obtained from the standard additivity rule to account for geometrical overlapping of atomic cross sections.

Preliminary results of relative DCSs for elastic electron scattering from furan molecule at 50, 75 and 100 eV, in the angular range from 25°-110° are presented in Fig. 1. Measured relative DCSs (full circles) and theoretical calculations (full curve), are normalized one to each other and compared. The shape of the experimental DCSs is well reproduced by the SCAR theory. Small disagreements appear for the lower energies (50 eV and 75 eV) in the low angular range. This could be due both experimental influences (since electron beam spreads with decreasing the incident electron energy) and less reliable SCAR DCSS at small scatering angles and low energies [3]. Present results are compared with experimental points reported by Khakoo et al. at 50 eV [6]. The later DCS generally show similar behaviour in the range from 40°-110°, however, a disagreement with the present theory is noticable at small angles. Note that the previous DCS [6] below 15° is obtained by extrapolating the experimental curve according to the theory.

To conclude, the elastic scattering of electrons from furan has been investigated and the relative DCSs were preliminary reported for the incident electron energies of 50, 75 and 100 eV. Generally, a good agreement between the present experiment and calculations, as well as with previous experimental results [6] is obtained. Further work is under run to extend the incident energy region and to determine absolute cross sections.

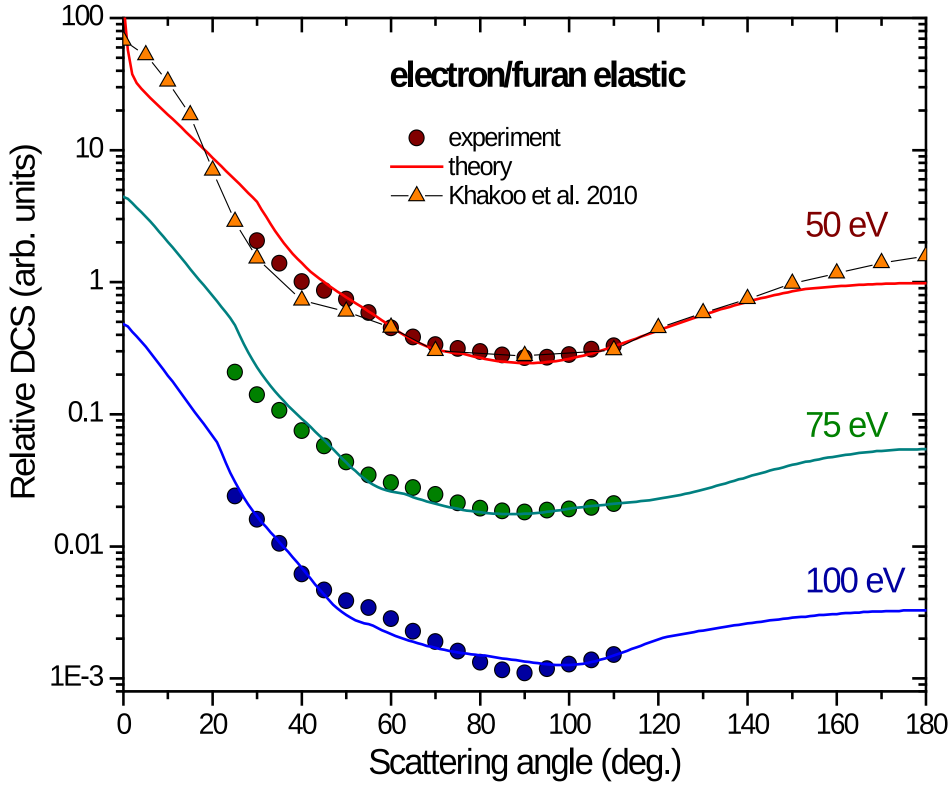

Fig. 1: Angular dependence of relative DCSs for elastic electron scattering from furan molecule. Full circles represent the experimental points, full lines represent the SCAR calculations and full triangles represent experimental points obtained by Khakoo et al. [6] .

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