Low energy differential elastic electron scattering from trichloromethane

Low energy differential elastic electron scattering from trichloromethane

B Diaz[1], G Tatreau[1], B Hlousek[1], M Zawadzki[1,2]* and M A Khakoo[1]†

[1]Department of Physics, California State University, Fullerton, California 92831, USA
[2]Atomic Physics Division, Department of Atomic, Molecular and Optical Physics, Faculty of Applied Physics and Mathematics, Gdańsk University of Technology, ul. Gabriela Narutowicza 11/12, 80-233 Gdańsk, Poland

Synopsis Experimental differential cross sections for low energy electron scattering from trichloromethane is measured utilizing a crossed electron-molecular beam experiment via the relative flow method, for the incident electron energies in the range of $E_0 = 0.5$ eV-30 eV and the scattering angles in the range of $\theta = 10^\circ - 130^\circ$.

Low-energy electron collision processes play an important role in several areas including astrophysics, radiation biology, atmospheric chemistry and technology. When considering the inelastic and elastic collisions, the former constitutes a dominant process of low-energy electron transport through gaseous media, plasmas and condensed matter. In our present work we provide the elastic differential cross sections (DCSs) for low energy electron scattering from trichloromethane - the organic compound with formula $CHCl_3$.

The experimental setup employs a crossed electron/target beam arrangement. The energy separation of electrons is made at high resolution (40-50 meV FWHM) using electrostatic lenses combined with hemispherical analyzers [1]. In order to accurately determine background scattered electrons we employ a movable collimated gas beam source [2] developed in our laboratory.

The DCSs for trichloromethane, $\mathcal{Q}_{\rm A}(E_0,\theta)$ are obtained from the relative-flow formula:

$$\mathcal{Q}_{\rm A}(E_0,\theta) = \mathcal{Q}_{\rm He}(E_0,\theta)\frac{\mathcal{R}_{\rm He}\, I_{S,{\rm A}}}{\mathcal{R}_{\rm A}\, I_{S,{\rm He}}}\sqrt{\frac{M_{\rm He}}{M_{\rm A}}}\ , \quad (1)$$

where $\mathcal{R}$ stands for the relative flow rates, I_S represents the scattering rates and M represents the molar masses where the subscripts indicate the gas species, with A being the unknown gas (trichloromethane) whose DCS is to be determined and He the standard gas (helium) whose DCSs are known; thus our measured trichloromethane DCSs were normalized to elastic DCSs for helium.

We will present the experimental data on differential cross sections for elastic electron scattering on $CHCl_3$ for range of energies (0.5, 1, 2, 3, 4, 5, 7, 10, 15, 20, 30 eV) and the scattering angles ($10^\circ - 130^\circ$). An example of the data for four incident electron energies is shown in Fig. 1.

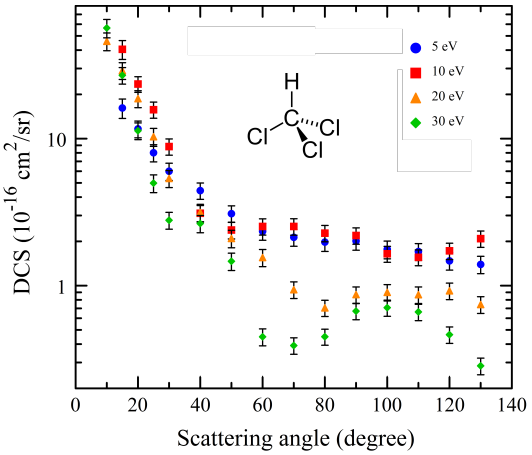

Figure 1. Differential cross sections for elastic electron scattering by trichloromethane.

Acknowledgments: The work carried out at California State University, Fullerton was funded by the National Science Foundation under grant NSF-RUI-PHY 1606905. M.Z. acknowledges the Fulbright Program to conduct this work at California State University Fullerton.

References

[1] Zawadzki M and Khakoo M A 2018 *J. Chem. Phys.* **149** 124304
[2] Hughes M, James Jr K E, Childers J G and Khakoo M A 2003 *Meas. Sci. Technol.* **14** 1

*E-mail: mateusz.zawadzki@pg.edu.pl
†E-mail: mkhakoo@fullerton.edu