

An Experimental Study of Elastic Electron Scattering from Fluorocarbon Radicals

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Declaration

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

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Jessica R. Brunton

Summary

This thesis reports the first measurements of elastic electron scattering differential and integral cross sections for the trifluoromethyl radical (CF_3) for incident electron energies in the range 7-50eV. In order to make those measurements, it was necessary to first measure elastic cross sections for electron scattering from iodotrifluoromethane (CF_3I), in that case over the 10-50eV energy range, and so those results are also presented. This thesis also includes an experimental investigation of low energy (2-20eV) elastic electron scattering from difluoromethylene (CF_2), another important radical species.

Chapter 1 consists of some general information about the CF_2 , CF_3 and CF_3I species, including an overview of the previous work undertaken in order to better understand their scattering behaviour. It also incorporates details about the present motivation for measuring electron scattering phenomena from each of them, along with the definitions and general importance of both differential and integral cross sections.

Chapter 2 presents the particulars of the apparatus that was employed for these measurements. It includes a summary of the design and operation for the three main components of the apparatus, including the pyrolytic assembly, the electron spectrometer and the current time of flight mass spectrometer.

Chapter 3 contains information pertaining to the experimental methods employed in this study. It includes details relating to our electron scattering data collection and analysis methods. This chapter also incorporates details related to the *in situ* production of both CF_2 and CF_3 , and information about extracting CF_3 cross sections from the direct measurements of those for “mixed species” gas beams.

Chapter 4 details our present results, beginning with the low energy elastic differential and integral cross sections for electron scattering from CF_2 . We then move on to present the differential and integral cross sections of CF_3I , a necessary precursor study towards our ultimate goal of investigating electron collisions with CF_3 . Thereafter we present our “mixed” beam differential cross sections (DCSs), followed by our extracted CF_3 DCSs and integral cross sections (ICSs). All of our results, where possible, are compared with the results from current theoretical investigations; including some so recent that they have not yet been published.

The main findings of this work are summarised in chapter 5, along with a couple of possible future directions this research might take. Lastly, unpublished theoretical differential cross section data for atomic and molecular iodine, vital for this current work, are presented in the appendices.

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