

Recent developments in absolute cross section measurements for dissociative electron ionization of and attachment to molecules

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Measurement of absolute cross sections for the production of various positive and negative ions from molecules by electron impact has been a difficult problem till very recently. While the total ion cross sections could be obtained fairly easily using a total ion tube [1], the partial cross section measurements posed problems due to the initial kinetic energy and angular distributions of the fragments ions. In order to obtain the absolute cross sections, it was necessary to collect and detect all the ions from an interaction volume of known target density and electron current density. While the relative flow technique [2] considerably reduced complexity of determining the target density and the electron current density and their overlap volume, the problems persisted in collecting, mass analyzing and detecting the fragment ions without discrimination against their initial kinetic energies, angular distributions and mass to charge ratios. A segmented time of flight mass spectrometer along with pulsed electron beam and pulsed ion extraction arrangement provided a very simple and clean solution for these problems [3]. A more recent advancement of this for the case of positive ions from simple molecules has been a combination of total ion tube technique with position sensitive detector, where mass to charge ratio separation was carried out using time of flight [4]. The latest advancement in these measurements applicable to both positive and negative ions has been the use of a momentum imaging time of flight mass spectrometer in combination with the relative flow technique to solve the 50 year old puzzle in the dissociative electron attachment cross sections for H₂ and D₂ [5]. While all these techniques could be used for molecules which have large enough vapour pressure at room temperature, a wide variety of important molecules remain as solids at room temperature with very small vapour pressure. Here again, a variation of the relative flow technique coupled to time of flight mass spectrometry has provided a relatively simple solution to the problem [6]. While presenting these techniques, the talk would cover various sources of systematic uncertainties and common pitfalls in these measurements

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