TOTAL CROSS SECTIONS FOR LOW ENERGY ELECTRON SCATTERING BY ORGANIC POLLUTANTS

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Total cross sections (TCS) are very important input data for codes that seek to simulate electron tracks on molecules samples, as they define the mean-free path between collisions. In order to produce new TCS and investigate the collision process of electron scattering by biomolecules, we have developed in the Laboratório de Física Atômica e Molecular - UFJF an experimental setup based on the measurement of the attenuation of a collimated electron beam through a gas cell containing the atoms or molecules to be studied at a given pressure. It consists essentially of an electron gun covering the energy range from 0.1 to 200 eV, a gas cell and an electron energy analyser composed of an array of decelerating electrostatic lenses, a cylindrical dispersive 127° analyser (CDA 127°) and a Faraday cup. The gun is housed inside a small vacuum chamber which is pumped differentially to avoid changes on the electron emission characteristics of the electron emitting filament which can take place as a result of filament cooling by additional background gas, when a gas sample is introduced into the gas cell. The collimated electron beam passes through the scattering cell consisting of a 30.0 mm long tube bounded by two apertures of diameters 1.0 mm (entrance and exit). The electrons that succeed in leaving the cell are discriminated with the electrostatic lens and the CDA 127°, which prevents electrons inelastically scattered in the forward direction being collected by the Faraday cup. The TCS, $\sigma(E)$, at given energy is determined in the transmission beam experiment from the Beer–Lambert law: $I(E) = Io(E)\, e^{-nL\sigma(E)}$, where $I_o(E)$ is the initial intensity of the electron beam, $I(E)$ is the intensity of the beam after travelling in the scattering gas medium, whose average particle number density is n. L is the path length of the electron beam through the gas cell; $\sigma(E)$ is determined by measuring the transmitted intensities with and without gas in the cell; n is taken to be equal to P/kT, using the ideal gas law, where P is pressure of the target measured with a Baratron, k is the Boltzmann constant and T is the absolute gas temperature. The pressure range of the target in the scattering cell was maintained between 1 and 4 mTorr, so that double scattering was negligible. The variation of $\ln(I_0/I)$ with the pressure P in mTorr is a straight line whose slope is a measure of the total scattering cross section. Our measurements were carried out for a given incident electron energy in at least four runs, each run taking at least seven pairs of values of P and I.

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