ELECTRON SCATTERING ON ATOMS AND MOLECULES: SEARCH FOR SEMI-EMPIRICAL INDICATIONS

Grzegorz P. Karwasz

Institute of Physics, University Nicolaus Copernicus, 87100 Toruń, Poland

Total and partial cross sections for electron scattering on atoms and molecules are the input data to modeling plasmas, interstellar media and radiation damage in biological tissues. In recent decades a significant progress was done in measurements of total cross sections (TCS) in a wide energy range (from few tens of eV to hundreds eV). However, in some experiments even if performed with absolute method [1], an interest for tiny resonant structure barely visible in TCS dominated over measurements in the low energy limit. Experimental TCS below 1 eV for polar molecules, important for plasma etching, disagree seriously with theories and semi-empirical scaling, see [2].

For partial cross sections only ionization is covered with sufficiently complementary methods: experiments using various techniques, see for ex. [3], semi-classical methods like Bethe-Born encounter model (BEB) [4], quantum scattering theories like optical models [5] and some "thumb-rules" [6]. Recently a semi-empirical method was proposed to extend BEB also to partial ionization cross sections [7].

Vibrational excitation in the near-to-threshold region can be pretty well (at least for the sake of plasma modeling) approximated by Born formula (see for ex. [2]) using values of transition dipole moments from measurements of IR and Raman absorption [8]. Recently, Born approximation for rotational excitation was applied successfully for such "exotic" processes as positron scattering on aminoacid tautomers [9]. A more systematic Born approximation browsing the near-to-threshold vibrational and rotational excitation in various targets is needed.

No semi-empirical method was tested for *resonant* vibrational cross sections. Comparison of total and integral elastic cross sections indicate that they constitute as much as 1/6 of TCS in shape resonances in N_2 and CO, and 1/3 of TCS in CO_2, N_2O, OCS. In CF_4 and NF_3 enhanced vibrational excitation (1/3 of TCS) seems to be related to huge transition dipole moments for some IR active modes [10]. For electronic excitation even such vague hints still lack.

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