Methylation effect in e^-— scattering on methyl-substituted ethylenes

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Synopsis Methylation effect has been observed and studied in electron-scattering from selected hydrocarbon molecules. In measured total cross section (TCS) functions we have noticed energy shifts and changes in the intensity of observed structures.

Electron-scattering cross sections data for hydrocarbons are of great importance in many fields of science and technology. Systematic studies of TCS for electron scattering from molecules allow also to notice relationships between shape and magnitude of TCS energy dependence and some physical properties of targets.

In this work, we present how methylation can affect TCS for ethylene and its methylated derivatives. All data have been obtained in our laboratory using the electrostatic 127° electron spectrometer working in the linear transmission mode [1].

Table 1. Location of the first maximum in TCS for studied targets.

Molecule	E_{1max} [eV]
Ethylene	1.9
Propene	2.2
2-Methylpropene	2.4
2-Methyl-2-butene	2.6
2,3-Dimethyl-2-butene	2.7

To investigate how the replacement of H atoms in target molecule with CH_3 affects TCS energy dependence, we compared results for ethylene [2], propene [3], 2-methylpropene [4], 2-methyl-2-butene [5] and 2,3-dimethyl-2-butene [5] molecules (fig. 1). Table 1 gives the location of low-energy TCS maxima: increase in the number of methyl groups in the molecule causes a shift of this structures toward higher energies. This effect can be associated with different redistribution of electric charge in the methyl-substituted molecules. A weak high-energy structure is also observed, near 25 eV, which becomes more pronounced as the number of CH_3 groups in a target molecule increases.

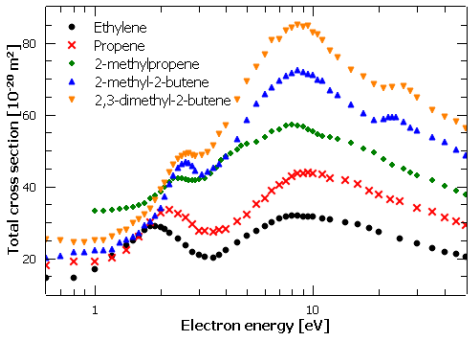

Figure 1. TCS for methyl-substituted ethylenes: ethylene [2], propene [3], 2-methylpropene [4], 2-methyl-2-butene [5] and 2,3-dimethyl-2-butene [5].

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References

[1] Szmytkowski Cz *et al* 2001 *Vacuum* **63** 549
[2] Szmytkowski Cz *et al* 2003 *Phys. Rev. A* **68** 032715
[3] Szmytkowski Cz *et al* 2002 *J. Phys. B: At. Mol. Opt. Phys.* **35** 3781
[4] Możejko P *et al* 2012 *J. Phys. B: At. Mol. Opt. Phys.* **45** 145203
[5] Szmytkowski Cz *et al* 2015 *J. Chem. Phys.* **143** 064306

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