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Role of methylation in electron scattering on $X(CH_3)_4$ (X = C, Si, Ge) molecules

S Stefanowska-Tur[1]*, Cz Szmytkowski[1] , E Ptasińska-Denga[1] and P Możejko[1]

[1]Department of Atomic, Molecular and Optical Physics, Faculty of Applied Physics and Mathematics, Gdańsk University of Technology, Gabriela Narutowicza 11/12, Gdańsk, 80-233, Poland

Synopsis Total cross sections (TCS) for low-energy electron scattering from $X(CH_3)_4$ (where X = C, Si, Ge) molecules have been measured using linear transmission method. Present results and those obtained previously for XH_4 molecules were used to determine how methylation of the target is reflected in TCS energy dependence.

In recent years, modern techniques of nanostructures production, like focused electron beam induced deposition (FEBID) method, are of great interest. The precursors used in FEBID method often contain methyl groups, therefore it is important to understand how the replacement of H atoms with CH_3 groups affects processes occuring during electron collisions. In this work, we present our investigation on the role of methylation based on TCS results for $X(CH_3)_4$ and XH_4 molecules.

The absolute total cross sections (TCS) for electron scattering from studied molecules have been measured using the electrostatic 127° electron spectrometer working within the linear transmission mode [1] for impact energies from 0.6 to 300 eV. The TCS at given electron energy has been obtained from intensities of transmitted electron currents taken in the absence and presence of target in the scattering chamber and the target vapour pressure.

To investigate how methylation affects TCS energy dependence, we carried out detailed analysis of experimental TCS for tetrahedral compounds of carbon, silicon and germanium XH_4 and for their fully methylated derivatives $X(CH_3)_4$ [2]. Preliminary results for Si compounds are shown in fig. 1. TCS curves are similar in the shape, but methylated molecule has additional enhancement extending between 12 and 20 eV. Simple estimation of TCS for 1,2,3 and 4 times methylated SiH_4 shows that high-energy structure becomes more visible with increasing number of CH_3 group in target. Analogous studies show the same dependence for C and Ge compounds. The main maxima of TCS are also shifted toward high energy for methylated molecules.

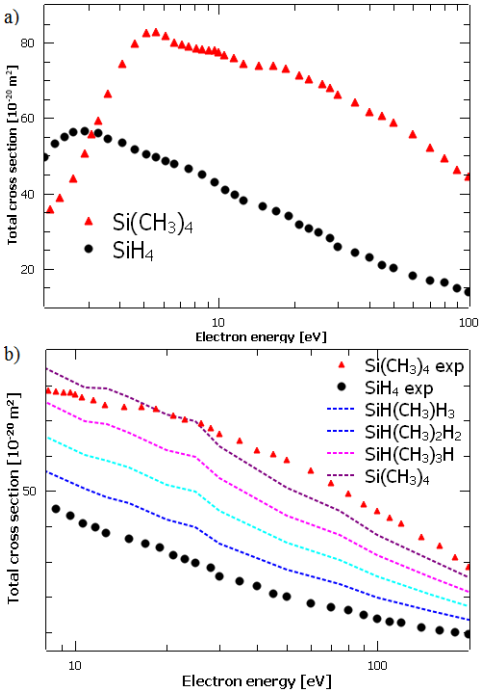

Figure 1. a) TCS for SiH_4 [3] and $Si(CH_3)_4$. b) Dot-dot lines mean estimated TCS for once, twice, three times and four times methylated SiH_4.

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References

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*E-mail: s141549@student.pg.edu.pl

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