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Absolute vibrational cross sections for low energy electron (1-19 eV) scattering from condensed tetrahydrofuran (THF)

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Absolute vibrational cross sections for low energy electron (1-19 eV) scattering from condensed tetrahydrofuran (THF)

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Synopsis Absolute cross sections (CSs) for vibrational excitation were obtained for low energy electron impact with tetrahydrofuran (THF) molecules condensed on Ar at 19K. The absolute CSs were measured with a high resolution electron energy loss spectrometer for the 1 to 19 eV incident electron energy range. The values of the vibrational CSs are found to lie within the 10^{-17}cm^2 range and to show the effects of resonant excitation.

A principal goal in radiotherapy is to deliver an important dose to cancer cells without affecting the healthy cells. One way to achieve this goal is by targeted radionuclide therapy (TRT) in which an Auger electron emitter is delivered directly to cancer cells to provide a lethal dose [1]. Modelling such treatments requires multiple parameters to describe the transport and reactions of secondary species in biological matter. Thus, absolute cross sections for the interactions of low energy electrons (LEE) with DNA and/or its component sub-units *in the condensed phase* are important for accurate nanodosimetric calculations [2] applicable to cells. Here we measure absolute cross sections for vibrational excitation of tetrahydrofuran (THF*) condensed on solid Ar*, to serve as a convenient model for the sugar within the DNA backbone [3].

Vibrational electron energy loss spectra for one monolayer (ML) of THF deposited on 3 ML of Ar spacer on a Pt substrate at 19 K, were recorded for electron incident energies 'E_0' between 1 and 19 eV. As in earlier studies [4], spectra were taken off-specular with monochromatized electrons incident at an angle of 15° with respect to the substrate normal and the electron analyzer at 45° in the opposite azimuth. The vibrational excitations observed for condensed THF were consistent with earlier experiments [3].

As previously described [4], cross sections for particular vibrational losses were obtained by fitting each energy loss spectrum with multiple Gaussian functions each centered at the expected energy loss for each vibrational mode.

CS values for representative vibrational excitations of THF are shown as a function of E_0 in Fig.1. Each excitation exhibits a maximum near E_0=2.5 eV, though the energy varies slightly between modes. The same structure appears in other modes at higher energy loss. It is likely this structure is associated with formation of a transient negative ion or resonance. The largest CSs measured was ~2×10^{-17}cm^2. A second, wider, resonance was observed at E_0=6.5 eV for the ν_{10} and ν_8 modes at 146 meV and 163 meV respectively and in some higher modes (not shown here). This research is funded by CIHR.

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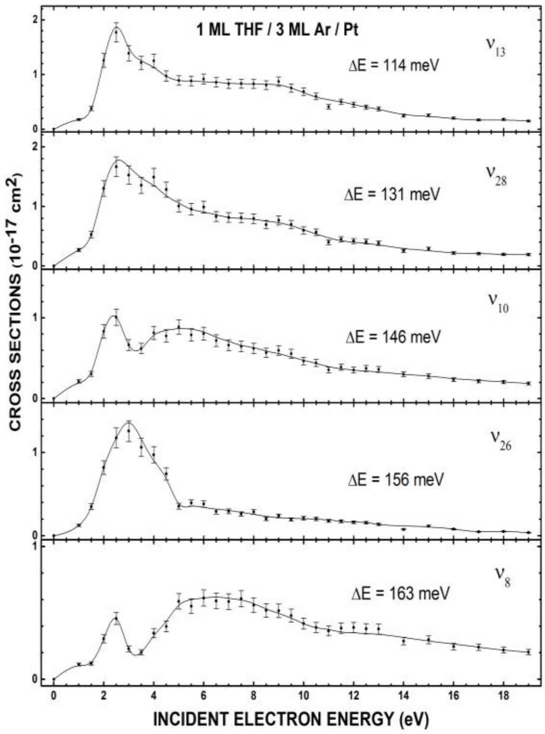

Figure 1. Representative absolute cross sections for electron impact excitation of the indicated vibrational modes of condensed THF molecules.

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