Cross sections for the ionization of tetrahydrofuran by light ions

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Synopsis Double differential cross sections (DDCS) for ionization of tetrahydrofuran by protons and helium ions were measured in the projectile energy range between 420 keV and 16.14 MeV at emission angles between 30° and 90° relative to the beam direction. The preliminary results for 420 keV protons indicate that the relative energy dependence of the experimental DDCS is in a better agreement with the modified Hansen-Kocbach-Stolterfoht (HKS) model [1] than with the recently reported calculation based on the dielectric response function (DRF) formalism [2].

Within the framework of the EMRP Joint Research Project "BioQuaRT" [3], a multi-scale track structure simulation program based on interaction cross sections of DNA constituents is under development [4]. As a prerequisite, ionization cross sections for model molecules representing DNA constituents are being determined.

Recently, double differential cross sections (DDCS) for ionization of tetrahydrofuran (THF) by proton and helium-ion impact were measured. The experiments were performed at the PTB ion accelerator facility [5] (Braunschweig, Germany) using monoenergetic protons with energies between 420 keV and 5.35 MeV, He^+ ions of 1.66 MeV and 2.01 MeV and He^{2+} ions of 16.14 MeV.

The emitted electrons were detected with an electrostatic hemispherical electron spectrometer. The mean radius of the analyzer is 65 mm, its acceptance angle and the relative energy resolution are about 3° and 1%, respectively. The spectrometer can be rotated around the symmetry axis of the scattering chamber (i.e. the direction of the gas beam). The secondary electron spectra were measured at emission angles 30°, 45°, 60°, 75° and 90° relative to the direction of the incident particles. These spectra are being converted into absolute cross sections using the collected electron spectra from the collision of 400 eV electrons with THF by referring to previously published cross section data for ionization of THF by electrons [6].

Figure 1 shows the relative energy dependence of the experimental DDCS (red dots) at observation angle 30° for 420 keV proton impact on THF. The experimental values are compared with the results of the modified HKS model [1] (blue solid line) and of the recently reported DRF calculation [2] (green dashed line). The experimental and the theoretical data were normalized to the respective DDCS at 100 eV electron energy. The relative energy dependence of the experimental DDCS agrees better with the modified HKS calculation.

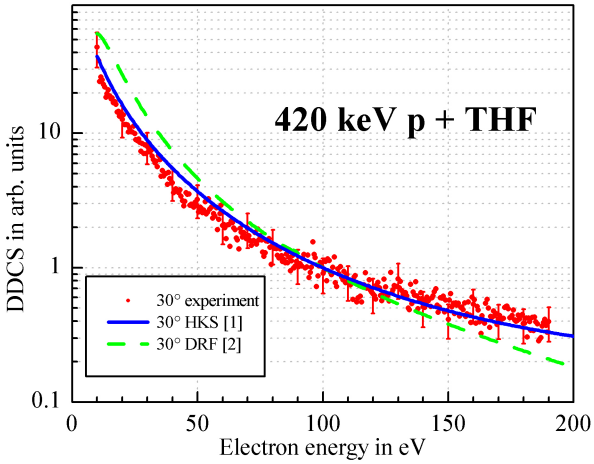

Figure 1. Comparison of the experimental (red dots) and the theoretical (blue solid [1] and green dashed [2] lines) DDCS as a function of the secondary electron energy at emission angle 30° for 420 keV proton impact on THF. The error bars indicate the estimated experimental uncertainties.

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