Excitation functions for positively charged fragments produced by electron impact on adenine

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Excitation functions for positively charged fragments produced by electron impact on adenine

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Synopsis Fragmentation of adenine in the gas phase is studied using low-energy electron impact. Positive ions have been detected using a reflectron time-of-flight mass spectrometer. Mass spectra have been measured as a function of electron impact from the ionization threshold to 400 eV, and excitation functions of most of the positively charged fragments have been extracted.

Electron impact induced fragmentation of the nucleobases is an important process for the understanding of radiation damage. When ionizing radiation passes through a biological medium, it produces a large amount of secondary particles along the radiation tracks, including low-energy electrons. Recent research has shown that low-energy electrons are very effective in causing DNA strand breaks.

Electron-impact fragmentation of adenine is being studied in an experiment at the National University of Ireland, Maynooth. A molecular beam of adenine is generated by resistively heating a small oven containing adenine powder. The oven is mounted in an expansion chamber, and the forward section of the beam effusing from a capillary in the oven passes through a skimmer into the collision chamber, where the beam is crossed by a pulsed electron beam. The electron gun consists of four electrostatic lens elements and a deflection system for steering the beam.

Positively charged fragments are mass resolved and detected using a reflectron time-of-flight mass spectrometer. LabView based data acquisition techniques are used to accumulate time-of-flight spectra as a function of electron impact energy.

An overview of the experiment can be found in [1]. The pulsed valve used in [1] for the generation of molecular clusters has been replaced by the resistively heated oven.

In this work two sets of mass spectra have been acquired. In the first set the electron impact energy was varied from 0.5 to 100 eV in steps of 0.5 eV, and in the second set the maximum energy was 400 eV and the stepsize was 2 eV. For both sets, groups of peaks were isolated and fitted with a sequence of normalized Gaussians, in order to determine the yields of the various fragment ions. The fitting was done automatically for all electron energies in succession, using a specially developed LabView program. In this way, excitation functions for most of the positively charged fragments have been determined.

Tests of the electron beam current have shown that the current is constant above about 15 eV, but decreases for lower energies. Because all excitation functions are generated from a single dataset, and assuming that the detection efficiency of the reflectron mass spectrometer is mass independent, above 15 eV the yields of all fragments are on the same relative scale and are comparable.

Mass spectra and excitation functions will be presented at the conference and will be compared with other research on adenine.

References

[1] G. Barrett and P. J. M. van der Burgt 2008 *J. Phys. Conf. Ser.* **101** 012008

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