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Abstract

The interaction of low-energy electrons ($< 15\,\mathrm{eV}$) with single molecules of biological interest is studied in the gas-phase by means of a crossed electron-molecular beams experiment. The anion yield following dissociative electron attachment (DEA) is measured as a function of the incident electron energy. Various dissociative pathways are identified. The following results were obtained:

- In adenine, cytosine and thymine dehydrogenation of the parent anion between 1 and 2 eV ist the preferred dissociation channel, in guanine it is the second intense. This reaction is driven by the high electron affinity of the corresponding nucleobase radical.
- By use of a partially deuterated isotopomer the hydrogen abstraction in thymine can be localized to occur exclusively at the nitrogen positions. Abstraction at the carbon positions is not observed in the investigated energy region (up to 10 eV).
- For thymidine we measure a dehydrogenated parent ion as well as rupture of the bond between sugar and nucleobase units.
- In presence of SF_6 some dehydrogenated parent anions (thymine, adenine, glycine) show a peak near zero eV, which can be explained by a dissociative electron transfer reaction giving HF and SF_5.

- The two main fragmentation channels in 5-bromouridine produce the bromine anion and the halogen containing nucleobase. The cross section for the first channel is about one to two orders of magnitude larger than the most dominant decay pathway in unhalogenated nucleobases. The results indicate that the interaction with low energy electrons play an important role in the action of a radiosensitizer.

- Partially deuterated glycine shows energy dependent site selectivity of hydrogen abstraction following electron attachment.

- The sulfur anion in experiments with cysteine observed in the low-energy region can be explained with a structural change from cysteine to alanine.

- Tryptophan and N-acetyl tryptophane show both distinctive DEA-induced fragmentations. In the former a 45 amu anion dominates the dissociation. In N-acetyl tryptophan the most intense reaction is the cleavage between the methylene indole and the acetylated glycine unit, on which the excess charge is located.

The present results demonstrate the potential of electrons for as little as subexcitation energies to effectively change the nature of DNA building blocks and amino acids.