Dissociation electron attachment to the DNA-water complex

Sylwia Ptasińska[1, 2] and Léon Sanche[1]

[1] Groupe en Science des Radiations, Faculté de médicine, Université de Sherbrooke, Sherbrooke, Québec, J1H5N4, Canada
[2] Department of Physics and Astronomy, The Open University, Walton Hall, Milton Keynes, MK7 6AA, United Kingdom
e-mail: s.ptasinska@open.ac.uk

Direct damage in DNA exposed to ionizing radiation involves a large quantity of electron addition and abstraction reactions on the DNA molecule. DNA and its constituents in the solid state provide excellent model systems in order to investigate indirect processes induced by those low energy secondary electrons.

In our previous studies electron stimulated anion desorption (ESAD) from thin films of a short single strand of DNA, namely the tetramers GCAT was investigated. The ion yield functions for light anions desorbed from GCAT exhibited resonant peaks between 6 and 12 eV, which indicates the dissociative electron attachment (DEA) to this molecule. Additionally, the comparison of the anion yield functions obtained from oligos to those obtained for corresponding anions from isolated DNA constituents shows that DEA processes found for the latter ones are still present within GCAT.

Given the essential role that water plays in radiation damage to DNA it is important to develop a complete understanding of the interaction between low energy electrons and DNA-water complexes at molecular or submolecular level.

Recently ESAD yields from GCAT were also recorded under hydrated conditions. The film of short single strands of DNA was covered by 3-monolayers of water (i.e., H_2O, D_2O or $^{18}H_2O$) which corresponds to 5.25 water molecules per nucleotide. Below 15 eV, H^-, O^- and OH^- anions emanate principally from a new type of dissociative core-excited transient anions formed via electron capture by a DNA-water complex.

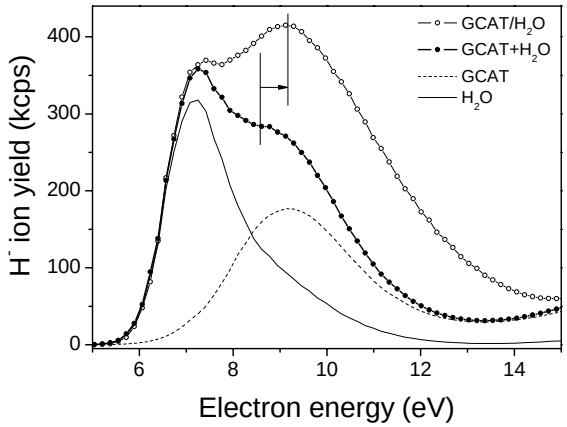

Fig. The H^- ion yield functions obtained from two-component film GCAT/H_2O, pure GCAT and H_2O. Additionally, the GCAT + H_2O curve represents the H^- signal which is the sum of desorption yields of both components. The comparison of that curve with those observed from two component target shows differences in the yield functions; the latter one has a larger magnitude and extends to higher energies, indicating that the H- signal arises from the dissociative transient anion which is originated from the GCAT •H_2O complex.