DNA Strand Breakage and Fragmentation Induced by Low Energy Ions.

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The effect of ionizing radiations upon biological material continues to evoke great scientific interest. It is well known that such radiations can cause undesirable biological consequences, particularly via damage to DNA.

Recent studies [1] have shown that low energy electrons (1-20 eV) are capable of damaging DNA and its components via a dissociative electron attachment process. Many other secondary species, including ions with energies up to ~ 1 keV (with various charge states) are produced [2]. These may give rise to electron capture dominated processes that have been shown, in gas phase studies, to lead to molecular dissociation [3].

Recently [4] we have investigated the damage induced in supercoiled plasmid DNA molecules by 1-6 keV carbon ions as a function of ion exposure, energy and charge state. The production of short linear fragments, through multiple double strand breaks, has been demonstrated and exponential exposure responses for each of the topoisomers have been found. The cross section for the loss of supercoiling was calculated to be $(2.2 \pm 0.5) \times 10^{-14}$ cm^2 for 2 keV C^+ ions. In the case of 2 keV doubly charged ions, the damage was greater than for singly charged ions of the same energy. These observations demonstrate that ion induced damage is a function of both the kinetic and potential energies of the ion.

We are currently developing a technique, based on laser desorption, for the production of gaseous targets of large biomolecules, including oligonucleotides. This will enable the study of single particle (ion, neutral, radical, electron) and photon interactions, free from the effects of the surrounding medium and will enable site specific fragmentation information to be obtained.

References

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