Negative ion resonances and radiation damage in biological targets.

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A significant fraction of the energy imparted to condensed matter from high-energy radiation is transferred via the production of secondary electrons with initial energies < 20 eV [**1**]. Prior to their thermalization, secondary electrons interact with the condensed medium in which they were generated. As a consequence, there is a need to investigate the condensed phase interactions of low energy electrons (LEE) and so identify their role in radiation damage to living systems. Such studies are possible using energy-selected LEE beams incident from vacuum upon thin solid film targets.

Experiments of this type on simple molecular solids have revealed that, as in the gas phase, scattering cross sections at low energies are dominated by the formation of negative ion resonances (i.e., short-lived anionic states) which can induced molecular damage by their decay into the dissociative electron attachment (DEA) channel or that of dissociating electronically excited states [**2**]. In recent years, these studies have begun to focus on biomolecular targets, including molecular DNA, which has been shown to be surprisingly susceptible to electron damage via resonances [**3**].

In this contribution, we will describe recent LEE impact experiments on thin films of biomolecules including water ice, plasmid DNA, deoxyribose analogues, DNA bases, protein sub-units and self-assembled monolayer films of short single strands of DNA. The energy dependence of the yields of various fragments induced by LEE impact on these compounds exhibit strong variations which are due to the formation of negative ion resonances. These experiments allow us to compare the variation in the yields of single and double strand breaks of the DNA backbone, to the desorption of anions following electron impact on pure samples of the DNA sub-units listed above. Furthermore, desorption experiments with single-stranded DNA, indicate that dissociation via transient anionic states produces neutral fragments, the yields of which are sensitive to the base identity and sequence in the oligonucliotide.

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