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Low energy electron induced fragmentation and reactions of DNA and its molecular components[1]

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Much research has been stimulated by the recognition that ionizing radiation can, in condensed matter, generate large numbers of secondary electrons with energies less than 20 eV [1] and by the experimental demonstration that such electrons may induce both single and double strand breaks in plasmid DNA [2]. Identifying the underlying mechanisms involves several research methodologies, from further experiments with DNA to studies of the electron interaction with the component 'sub-units' of DNA in both the gas and condensed phases [3]. In particular, understanding electron-induced strand break damage, the type of damage most difficult for organisms to repair, necessitates study of the sub-units of DNA back-bone, and here Tetrahyrofuran (THF) and its derivatives, provide a useful model for the furyl ring at the centre of the deoxyribose sugar. In this contribution, we review with particular reference to DNA and related molecules, the use of electron spectroscopy and mass spectrometry to study electron-induced fragmentation and reactions in thin molecular solids. We describe a newly completed instrument that combines laser post-ionization with a time-of-flight mass analyzer for highly sensitive ion and neutral detection. Use of the instrument is illustrated with results for THF and derivatives. Anion desorption measurements reveal the role of transient negative ions (TNI) and Dissociative Electron Attachment in significant molecular fragmentation and permit effective cross sections for this electron-induced damage to be obtained. The neutral yield functions also illustrate the importance of TNI, mirroring features seen in recently measured cross sections for electron induced aldehyde production in THF [4].

1. J. A. Laverne and S. M. Pimblott, Radiat. Res. **141**, 208 (1995)
2. B. Boudaiffa, et al, Science **287**, 1658 (2000)
3. L. Sanche. Physica Scripta. **68**, C108, (2003)
4. S.-P. Breton, et al.,J. Chem. Phys. **121**, 11240 (2004)

[1]Work done in the lab of L. Sanche