Anion TOF detection for electron transfer in atom-biomolecule collision experiments

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The effects of ionising radiation on biological material has been studied using tissue samples for many years. However, research to understand radiation induced damage at a molecular level has only begun recently. Relatively few experiments have been carried out on the effects of ionising radiation and secondary electrons on key biological molecules such as DNA and its constituent bases. It is well known that for each MeV of incident radiation, ~ 10^4 secondary electrons are produced with an energy distribution from 0 eV, extending up to 30 eV [1]. The effects of electron capture by biological molecular structures leading, in the low energy region (0 – 20 eV), to the formation of transient negative ions (TNI) that may dissociate and produce molecular degradation has only recently been discovered [2].

In the present experiments we are studying the formation of negative ions in a crossed molecular beam configuration, where a neutral beam of potassium atoms, formed in a charge exchange source, crosses at right angles an effusive molecular target produced in a hot gas cell. Negative ions formed in the collision region are extracted into a TOF mass spectrometer. These experiments will allow us to probe whether electron transfer process via a TNI is a correct model for electron transport in DNA or whether electron harpooning by bound electrons supplied in K - molecule scattering is a more appropriate model for electron transport under physiological conditions.

Optimisation of the resolution of the TOF spectrometer has been our main goal during the last few months, mainly because we need to be able to distinguish consecutive masses without interfering with the kinetic energy release distribution profiles of the anionic fragments. Some preliminary negative ion spectra have been obtained from thymine and nitromethane and will be presented at the meeting together with discussion of further improvements to the TOF apparatus.

References:

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