REPORT ON THE VISIT

The purpose of the visit was to study the interaction of electrons with plasmid DNA. My role in this project was to provide the material for investigation, handle it and provide the method of further data analysis. As a benefit for me was the possibility to use the electron source present at the Aarhus University and learn more about the high vacuum systems. Also the results could be nicely integrated in the general theme of my work elsewhere, that is, DNA damage in general.

The apparatus that was used for the irradiation studies at Aarhus is specifically designed for the irradiation of solid material. The aim of these experiments is to investigate the interaction of electrons in the low energy region <0.5 eV using a high resolution (~1 meV) electron beam produced via the photoionization of argon. However, the purpose of this visit was to show first that we could obtain DNA damage with low energy electrons and to establish at Aarhus the techniques for this project. Experiments carried out in this visit used a trochoidal electron monochromator as the electron source which allows the study of interactions of electrons between energies of a few hundred meV to 10 eV with a resolution of 200 meV. This source can deliver currents of up to 50 nA or more. Analysis of DNA samples was performed by gel electrophoresis.

DNA samples (plasmid pBR322 DNA was used in all the experiments) of various concentrations were placed on tantalum disks and irradiated at the energies of 10, 5 and 1 eV with various times and electron currents. Each time a control sample, not exposed to the electron beam, was present in the vacuum system.

Furthermore, various drying techniques, such as freeze-drying, gentle overnight pumping and rapid evaporation, were tested to establish the optimal preparation conditions.

The results obtained during the visit showed that

(i) Damage could indeed be observed, very readily at 10 eV where earlier work Boudaïffa, *et al.*, *Science* **287**, 1658 (2000) found a maximum in the damage cross-section.

(ii) We could observe both double strand and single strand breaks

(iii) Our experiments showed that the cross-section reported in earlier work for single strand breaks (SSB) is reproduced within experimental error. The cross-sections for SSBs and DSBs at 10 eV were found by us to be ~$7 \cdot 10^{-15}$ cm^2 and $2.4 \cdot 10^{-15}$ cm^2 (±>50%), respectively, as compared

with the reported values (Boudaïffa, et al., *Radiation Research* **157**, 227 (2002)) of $3.4 \cdot 10^{-15}$ cm^2 and $2.6 \cdot 10^{-15}$ cm^2, correspondingly.

(iv) We have established a protocol fro DNA handling, e.g. freeze-drying, use of controls and gel electrophoresis.

For future work it is recommended that these experiments are repeated, so the statistical error could be decreased. Moreover, the sample area definition should be improved, so the results will not contain this additional experimental uncertainty. This would appear to be the start of a successful project which I hope to be involved with in the near future.