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REFERENCE: Short Term Scientific Mission, COST P9
Beneficiary: Rodrigo Antunes, New University of Lisbon
Host: Prof. Dr. Paul Scheier, University of Innsbruck, Innsbruck, Austria
Period: from 11/01/2007 to 24/01/2007 Place: Innsbruck - Austria
Reference code: COST-STSM-P9-00206

SCIENTIFIC REPORT

PURPOSE OF VISIT

The interaction of high energy radiation (alpha, beta, gamma rays or heavy ions) with living cells does not in general lead directly to DNA strand breaks. The primary interaction acts as a source of secondary electrons produced per 1 MeV primary radiation with an energy distribution up to 30 eV. The process of low energy electron attachment is of particular interest since it provides a mechanism for selective bond breaking within the molecular target. As far as biological relevant molecules are concerned, such experiments have important consequences for determining the level of exposure to low ionising energy radiation and the effects of exposure to low doses but long time exposures, both of which are topical studies in the health (radiation) sciences. Dissociative electron attachment experiments can be performed in the Innsbruck laboratories by taking advantage of low energy electron guns, with electron energy resolutions as good as 30 meV, in combination with several mass spectrometer systems. Negative ion yields are measured as a function of the electron energy and the role of the electronic (excited) states are assessed.

DESCRIPTION OF THE WORK CARRIED OUT DURING THE VISIT

During my visit to Innsbruck, I had the opportunity to work together with a PhD Student (Ingo Mähr) and a Post-Doc (Fabio Zappa). I took part on an experiment concerning the mass spectrometric investigation of ions formed upon free electron attachment to nucleobase molecules (valine) embedded in helium clusters.

In this experiment pure and water doped clusters of valine were formed by picking isolated nucleobase molecules in cold helium droplets, which were bombarded with low energy electrons (< 20 eV). The ion fragments resulting from the electron attachment of these low energy free-electrons to the valine clusters were monitored by a mass spectrometer.

In this experiment, the apparatus utilized, consists of two sections: the neutral target preparation part and the mass spectrometer section. Helium droplets with an average size of about 10^5 atoms are formed by expansion of pristine helium at 15 bar pressure and a temperature of 9.6 K through a $5\mu\text{m}$ nozzle. The droplets are doped with gas phase biomolecules (valine in the present study) that are vaporized in an oven and water. Thereby cold (0.37 K) complexes of water and biomolecules are formed inside the superfluid He droplet and carried to the ion source of a double focusing sector field mass spectrometer. Positively and negatively charged ions are formed upon interaction of free electrons with the doped droplets and the ions are mass spectrometrically analyzed.

I had a chance to work on another experiment on free-electron attachment with aminoacids (glycine). Another relevant aspect of this visit was the discussion of some technical details concerning the TOF experimental set up, which was very important since we are trying to set-up a detection system for our experimental apparatus in Portugal for atom-molecule experiments by charge transfer.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

- Throughout my visit to the lab, it was possible to get both negative and positive ion spectra for valine cluster doped with normal and heavy water. These spectra include mass scans, energy scans and MIKE scans for some fragments.

FUTURE COLLABORATION WITH HOST INSTITUTIONS

Due to the link with the Innsbruck laboratory, the study of other relevant biomolecular targets is being planned for the near future. A possible visit to Paul Scheier's lab is also planned.

PROJECTED PUBLICATIONS/ARTICLES RESULTING OR TO RESULT FROM THE STSM

The results obtained will certainly be worked up in order to prepare at least one joint publication to be submitted to an international journal as soon as possible.

Rodrigo Antunes

Lisbon, 12th February 2007.

CONFIRMATION BY THE HOST INSTITUTE OF THE SUCCESSFUL EXECUTION OF THE MISSION

The visit of Rodrigo Antunes was accomplished with success and according to the planned activities.

Prof. Dr. Paul Scheier

Innsbruck, 12th February 2007.