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Scientific report

Biological macro molecules are of great interest for their potential application in nano-technology where they can be used as building blocks for complex systems [Schiffrin07]. Also the possibility to link individual DNA strands/fragments to a suitable surface has large potential in the fabrication of biological "nano-arrays" [Hamers05]. However, the experimental investigation of relevant molecular systems such as nucleosides, sugar phosphates, and nucleotides is particularly challenging since they are thermally labile and non volatile. A very promising method to overcome the experimental shortcomings and to enable the study of neutral molecular systems in the gas phase is laser induced acoustic desorption (LIAD) [Shea07,Bald08]. Currently the group of Prof. Ingólfsson is building up this experimental approach.

The LIAD experimental setup is in the final assembling phase. It combines a pulsed Nd:YAG laser, a translatable sample holder, a trochoidal electron monochromator (TEM), and a quadrupolar mass spectrometer (QMS). A malfunctioning in the QMS has limited the range of performable tests of the system, although the electron beam delivered by the trochoidal monochromator was optimized (filament, optics and magnetic field).

The aim of the visit was to start a collaboration between the groups in Reykjavík and Orsay in the field of fundamental processes involved in the interaction of low-energy electrons with molecular systems of biological interest. The time allowed to this STSM was used to discuss and define common systems of interest (DNA basis hexamers) and the requirements for irradiation of dried solution deposits: conditions of deposition, minimization of the sample charging and of the heating… A very raw irradiation setup, basically a sample holder with a lens, was realized to test the feasibility of an irradiation. The reflexion undertaken enabled us to prepare an application to a scientific call for bilateral cooperation (Jules Verne Programme) on electron irradiation of DNA fragments by low-energy electrons. The complementary experimental techniques that will be used are MALDI-TOF spectroscopy (in Reykjavík) and mass analysis of the neutral fragments desorbing during the irradiation (in Orsay).

This STSM gave me also the occasion to give a seminar/lecture for graduated students on "Low-Energy Electron Driven Processes in Ices: Surface Functionalization and Synthesis Reactions" (MÁLSTOFA efnafræðiskorar, Seminar of the Department of Chemistry, Háskóli Íslands, 14 août 2009).

[Schiffrin07] e.g. A. Schiffrin, A. Riemann, W. Auwärter, Y. Pennec, A. Weber-Bargioni, D. Cvetko, A. Cossaro, A. Morgante, J. Barth, PNAS 104 (2007) 5279

[Hamers05] R.J. Hamers, J.E. Butler, T. Lasseter, B.M. Nichols, J.N. Russell Jr., K.-Y. Tse, W. Yang, Molecular and biomolecular monolayers on diamond as an interface to biology, Diam. Relat. Mater. 14 (2005) 661

[Shea07] R.C. Shea et al., Analytical Chemistry 79 (2007) 1825

[Bald08] I. Bald et al., Angew. Chem. Int. Ed. 47 (2008) 8518; I. Bald PhD thesis, Freie Universität Berlin, 2007, http://www.diss.fu-berlin.de/2007/860