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Słupsk, November 2nd, 2005

Research exchange programme for the stay at Berlin Freie Universität by Dr Grzegorz Karwasz, within ESF Electron-Induced Processes in Atoms and Molecules (EIPAM) Programme

Rapport for the exchange grant for the period 10. 07. 2005- 28. 10. 2005

Subject of the exchange:
"Electron-induced negative ion formation in molecules of biological interest"

Purpose of the visit
The main purpose of the visit was to study formation of negative ions and electron- driven reactions in molecules in the gas phase. The aim was to learn innovative techniques used at FU Berlin, in studies of chemical reactions initiated by electron attachment to single molecules and clusters.

Work carried out

The trainee worked essentially on two experiments: on electron trochoidal spectrometer for electron attachment to molecules in clusters and, mainly, on the experimental set-up for studies of electron induced reactions and thermal desorption from solid nano-films.

In the first phase, low-energy electron attachment to trifluoro-acetic acid in clusters was studied. Tyhe goal was a systematic search of the electron-scattering resonances in two energy regions - sharp structures below 2 eV, and wide resonances above 5 eV. Mass spectra at given electron energies evidenced the richness of the decay channels, ion-yields at variable electron energies indicate transient-negative ion resonances.

Studies of the acetic acid, also in fluorinated form were performed (the simplest amino-acid, glycine is based on it). Although negative ions were observed, no desired reaction channels have been reached.

Additional work in the field of positron- induced chemistry, based on the experimental data obtained previously were done bye the trainee, with two papers in this field issued during the stage in Berlin.

The trainee delivered a internal seminars on
"Ab-initio studies of formac acid clusters" and participated in "Vth Low-electron negative-ions" seminar in Bratyslava.

Results

Main results was identification of decay channels of transient negative ions of trifluoro-acetic acid with 3- 8 monolayers. Decay channels vary with the attached electron collision energy. Low energy resonances leading to detachment of one H atom or F atom or formation of stable negative ions have been identified. Measurements with deuterated acid allowed to identify the chemical bond being preferentially cut.

Detailed measurements for electron collision energies up to 15 eV allowed to identify additional decay channels, related to new resonances [2].

Publications

Two publications concerning the subject of electron attachment and chemical reactions in trifluoro acetic acid clusters have been prepared [1, 2]. Two more works, concerning previous subjects have been published [3,4].

Papers

[1] J. Langer, I. Martin, G. Karwasz, E. Illenberger, Chemical reactions in clusters of trifluoroacetic acid (CF3COOH) triggered by electrons at subexcitation energy (< 2 eV), Int. J. Mass Spectr. Ion Proc., accepted

[2] M. Orzol, T. Sedlacko, I. Langer, G. Karwasz, E. Illenberger, Chemical reactions in thin filmd of trifluoroacetic acid induced by low energy electrons, in preparation

[3] Positron scattering in helium: virtual - positronium resonances, G.P. Karwasz, D. Pliszka, A. Zecca, R.S. Brusa, Nucl. Instr. Meth. B, 240 (2005) 666

[4] Positrons - an alternative probe to electron scattering, G.P. Karwasz,
Eur. Phys. J. D 35 (2005) 267