

Jan SKALNY

Department of Plasma Physics, Comenius University

Mlynska dolina F-2, 84248 Bratislava, Slovakia

Skalny@fmph.uniba.sk

REFERENCE: Short Term Scientific Mission, COST P9

Beneficiary: Jan SKALNY, Comenius University Bratislava

Host: Prof. Tilmann Märk, Institute for Ion Physics, University of Innsbruck

Period: from 10/12/2004 to 20/12/2004 Place: Innsbruck

Reference code: COST-STSM-P9-00834

SCIENTIFIC REPORT

PURPOSE OF VISIT

The collaboration between the Plasma physics group at Comenius University Bratislava and the Institute of Ion Physics at University of Innsbruck has been launched years ago. Several scientific projects have been successfully accomplished in collaboration between mentioned institutions. The research was focused to the study of electron impact processes with various gaseous molecules at ambient and also at elevated gas temperatures by using the crossed electron-molecular beams apparatus. Recently the new thermo-regulated source of molecular beam was designed and manufactured in Bratislava and finally installed on apparatus CELIA located in Innsbruck. The construction of the source enables to stabilize the temperature of tested gas within the temperature interval (260-460) K. Hence the temperature dependence of cross section for various electron impacts stimulated processes can be studied.

The aim of planned STSM is to optimize the regime of the mentioned beam source installed on CELIA apparatus for the study of reactions of low energy electrons with bio-molecules or molecules relevant to bioprocesses.

DESCRIPTION OF THE WORK CARRIED OUT DURING THE VISIT

The goal of intended experiments was to study the effect of gas temperature on the electron attachment to nitromethane CH_3NO_2 within the electron energy range (0-10) eV and used this

chemical compounds for optimisation of regime of molecular beam source. Due to some changes in research program in Innsbruck the effect of gas temperature on electron attachment to benzene was investigated. Benzene belongs to basic chemical compounds in many biomolecules. Until now only one study was dedicated to problem of interaction of low energy electrons with such compounds. The mentioned experiments were conducted at ambient temperature (H.P. Fenzlaff and E. Illenberger, Int. J. Mass Spectr. and Ion Processes, 59 (1984), 185). The aim of our experiments was to confirm or exclude the active role of dissociative electron attachment in the destruction of biomolecules containing in structure benzene or its derivatives even at high temperature up to 600 K.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

The dominant anionic fragment C_2H^- was observed at ambient temperature approx. 300 K and also at elevated temperature of molecular gas source 600 K. The resonance energy of this is at 9 eV. The amplitude of the cross section calibrated by using the reference signal of CCl_4 was relatively low, of $1.0 \times 10^{-20} \text{ cm}^2$. Moreover $C_6H_5^-$ and $C_4H_3^-$ anionic fragments of benzene structure were also observed in spectra, however the cross section for formation process of both mentioned fragments is even one order below the value of amplitude observed in case of the dominant ion C_2H^- . Ion yield spectra corresponded to the cross section for the particular process and were calibrated by using CCl_4 . The vibrational temperature of the benzene molecules has been changed in the range 30 -600 K, but no visible effects in the shape of the resonances as well as in the magnitude of the cross section have been observed.

The observed cross sections suggest that the DEA to benzene is probably not responsible for the observed effective destruction of benzene and benzene containing biomolecules by low energy electrons.

The working regime of molecular source was optimised within the interval 300-600 K.

FUTURE COLLABORATION WITH HOST INSTITUTIONS

The obtained preliminary results must be completed by measurement of H^- anions. Moreover for the study of destruction of cyclic molecules by low energy electrons the cyclohexane molecule should be tested by the similar method including the observation of temperature effect on the

dissociative electron attachment. Experiments will be performed in Innsbruck as well as in Bratislava, where another type of source for formation of molecular beam is used.

PROJECTED PUBLICATIONS/ARTICLES RESULTING OR TO RESULT FROM THE STSM

The preliminary results must be completed in accordance with foregoing item. Then these will be appropriate for publication.

Jan Skalny

Bratislava 22 December, 2004.

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

The visit of Prof. Jan Skalny was underdone with success and in accordance with the planed activities. The use of benzene instead of nitro methane was initiated by changes of the research plan of laboratory in Innsbruck. The studied benzene molecule is relevant to the program COST P9.

Prof. Tilmann Märk

Innsbruck, 20 December, 2004.