



First Workshop of the
ESF Programme

Electron Induced Processing at the Molecular Level (EIPAM)

The Open University, Milton Keynes, UK
19th – 20th April 2005

Electron Induced Processing at the Molecular Level (EIPAM)

Welcome to the Open University!

Welcome to this the first workshop of the ESF Programme on Electron Induced Processing at the Molecular Level (EIPAM). The Programme has been active since July 2004 with the first EIPAM Fellows being appointed in September and the first short exchange visits having taken place. However this workshop is the first opportunity to bring together the major partners involved in the programme to discuss the scientific policy of the programme (the initial meeting of the Steering group held in Lyons in June 2004 being a purely administrative action). Each of the main partners will present a review of their research and discuss its future direction. The meeting will also provide the opportunity for discussing which EU research groups that would benefit from being invited to participate in the programme.

The Workshop is arranged in sessions which reflect the scope of the programme including both experimental and theoretical research. *The meeting will conclude with my own Professorial inaugural lecture to which I am delighted to welcome colleagues and friends !*

The meeting will also include the Second meeting of the Steering Committee at which our ESF co-ordinator Ms Chantal Durant will be present to discuss administrative arrangements and budgetary issues.

Scientific Summary:

The ability to understand, manipulate and control physico-chemical processes at the molecular level is one of the great challenges of modern research and underpins the development of vibrant new technologies of the 21st century, for example the development of nanolithography. Such *single molecule engineering* requires selective bond cleavage in target molecules to allow subsequent management of the local site chemistry. Recent research has revealed that it is possible to influence the excitation and dissociation of molecules through the manipulation of electron interactions at the individual molecular level. Since electrons are ubiquitous in nature and electron induced reactions (in the gaseous phase, on surfaces and in the condensed phase) initiate and drive the basic physical-chemical processes in many areas of science and technology from industrial plasmas to living tissues our ability to control electron interactions provides exciting new opportunities that can now be exploited by both the research and technological communities. For example, the development of the Scanning Tunnel Microscope (STM) -an electron emitter- has introduced the capability of atomic-scale imaging, analysis and individual atomic/molecular manipulation providing a new technology that has the opportunity to revolutionize the scientific approach in many aspects of both the material and life sciences.

Currently several European groups are at the forefront of such pioneering research but, in contrast to the USA and Japan, the European research effort is fragmented and coordination is rudimentary or absent. The present ESF programme **Electron Induced Processing at the Molecular Level (EIPAM)** has been designed to bring together Europe's leading experimental and theoretical groups in a large-scale, multidisciplinary and collaborative research programme that will both maintain its international excellence and establish Europe as the centre for investigations of molecular control through electron processing with direct relevance in many areas from the basic sciences to industrial applications.

Programme

Monday April 18th 2005

Participants arrive

Tuesday April 19th 2005

All talks to be held in the Systems Seminar Room, Venables Building.

	<u>Title</u>	
09.00	Opening	Professor Nigel Mason
09.10 to 09.50	Low Energy Electron Induced Processes in Dielectrics, Icy Satellites, Stratospheric Clouds, Nanolithography and Radiotherapy	Professor Léon Sanche
09.50 to 10.20	Electron Processing at Sub-Excitation Energies	Professor Eugen Illenberger
<i>10.20 to 10.40</i>	<i>Coffee</i>	
10.40 to 11.10	Low Energy Electron Interactions with Biologically Relevant Molecules	Professor Paul Scheier
11.10 to 11.40	Probing Molecules with Slow Electrons and Positrons Impacting on Gaseous Targets	Professor F Gianturco
11.40 to 12.10	R-matrix Calculations of Electron-Molecule Collisions at Low and Intermediate Energies	Prof. Jonathan Tennyson
12.10 to 12.40	Long-lived Hydrogen Molecular Anions	Professor Jiri Horacek
<i>12.40 to 14.00</i>	<i>Lunch – EIPAM Steering Group Meeting</i>	ESF Representative Attending Ms Chantal Durant

Tuesday April 19th 2005 continued

14.00 to 14.30	Coupled Electron-ion Dynamics	Professor Andrew Fisher
14.30 to 15.00	Electron and Force Induced Molecular Manipulations: Molecular Engines and Switches	Prof. Karl-Heinz Reider/ Dr J Pascual
15.00 to 15.30	Simulation of High-Resolution Scanning Tunneling Microscopy and Spectroscopy: Present State of the Art and Comparison with Experiments	Dr Werner A Hofer
15.30 to 16.00	Electron-Induced Processes in Single Atoms and Molecules on Surfaces	Professor M Persson
16.00 to 16.30	<i>Tea</i>	
16.30 to 17.00	Modification of Thin Molecular Films by Low-Energy Electrons	Prof. Dr. Petra Swiderek
17.00 to 17.30	Electron Induced Functionalization of Semiconductors: the Case of Polycrystalline Diamond	Professor Roger Azria
17.30 to 18.00	Single Molecule Desorption and Dissociation at Room Temperature	Prof. Dr. Richard Palmer
19.00	<i>Dinner at MacDonald Parkside Hotel</i>	

Wednesday 20th April 2005

	<u>Title</u>	
09.00 to 09.30	Cold Electron Chemistry in the Gas Phase: Benchmark Experiments	Professor David Field
09.30 to 10.00	Benchmark Cross Sections for Low-Energy Electron Attachment to Molecules with Well-Defined Internal Temperature	Professor H Hotop
10.00 to 10.30	Elastic and Vibrational Excitation Cross Sections in Methane and Cyclopropane	Professor M Allan
<i>10.30 to 11.00</i>	<i>Coffee</i>	
11.00 to 11.30	Electron Scattering by DNA Bases at Intermediate and High Energies	Dr Gustavo Garcia
11.30 to 12.00	Synchrotron Radiation as a Tool for Probing the VUV Spectroscopy of Biomolecules	Dr Paulo Limao-Vieira
12.00 to 12.30	Temperature Dependence of Electron-Induced Reactions	Dr Stefan Matejcik
<i>12.30 to 14.00</i>	<i>Lunch</i>	
14.00 to 14.30	Electron Scattering by THF Molecule	Dr. Bratislav P Marinkovic
14.30 to 15.00	Electron-Molecule Interactions Studied in Electron Backscattering Experiments	Professor Mariusz Zubek
15.00 to 15.30	Lab Opening/Tour	
<i>15.30 to 16.00</i>	<i>Tea</i>	
16.00	Inaugural Lecture – Probing the Molecular world; Adventures with Electrons and Light <i>To be held in the Berrill Lecture Theatre</i>	Professor Nigel Mason
17.00	<i>Reception/Buffer</i>	

Electron Scattering by THF Molecule

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The backbone of the DNA molecule may be seen as a series of tetrahydrofuran (THF) molecules connected by phosphate bonds to which the bases are attached. Qualitative estimation of effects linked to chemical and structural changes of cellular DNA connected with radiation damage is performed by electron interactions with THF (C₄H₈O) sugar-like analogue molecule in gas phase. We report results for elastic scattering of electrons as a function of angle and electron impact energies. The absolute elastic differential cross section (DCS) as a function of scattering angle (10°-110°) is presented at impact electron energy range from 10 to 300 eV. Experimental set-ups used in the experiment are two electron spectrometers designed for lower and higher energy ranges, the first being of hemispherical electrostatic type and the other of double cylindrical mirror type.