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RESEARCH CONFERENCES

ESF-FWF Conference in Partnership with LFUI

Chemical Control with Electrons and Photons

Universitätszentrum Obergurgl
(Ötz Valley, near Innsbruck) • Austria
22-27 November 2008

Chair: **Petra Swiderek**, Universität Bremen, DE
Co-Chair: **Nigel Mason**, Open University, UK

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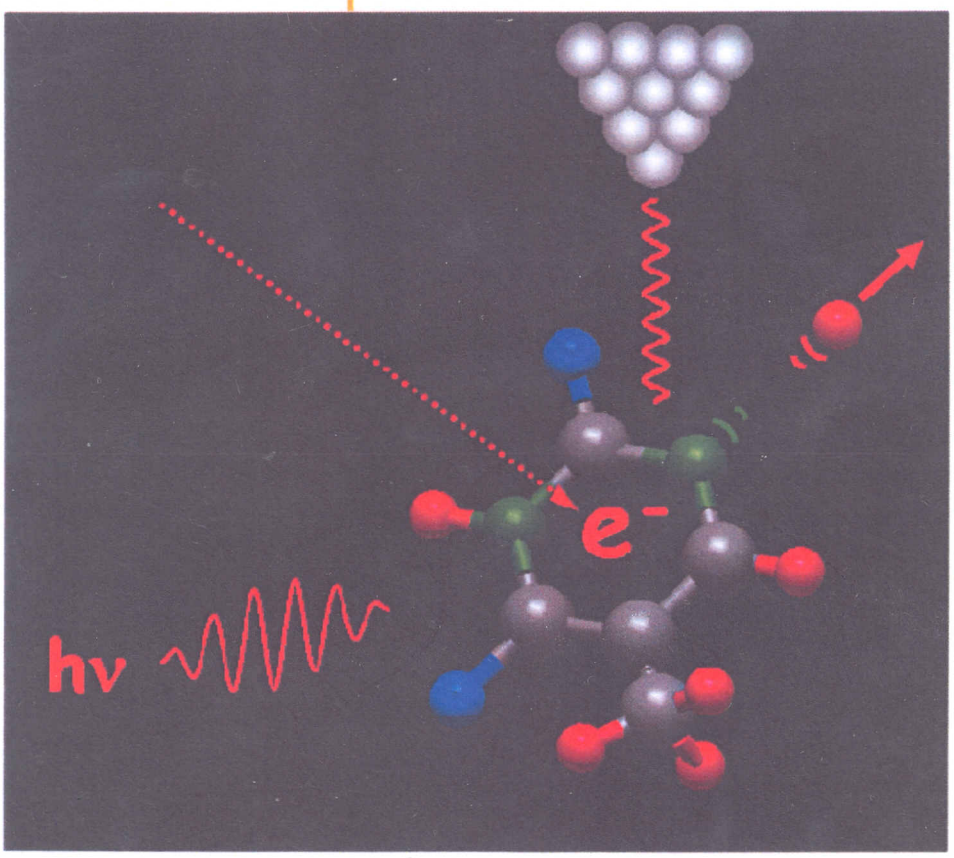

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Transmission of low-energy electrons through insulating nanocapillaries

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The work is focused on electron transmission through insulating large aspect ratio Al_2O_3 nanocapillaries, with diameter ranging from about 40 to 250 nm and length of 15 μm, for low incident electron energies from 2 eV to 350 eV. The measurements are performed using two different apparata and different experimental set-ups to investigate an energy dependence of the transmission rate and angular distribution of transmitted electrons both with and without an energy analysis, as well as electron energy loss of transmitted electrons, time dependence of transmission and other relevant parameters.

The transmission of charged particles through insulating nanocapillaries has been attracting a great deal of attention in recent years, since Stolterfoht et al. in 2002 [1] reported an experiment showing a guiding of slow positive ions (3 keV Ne^{7+}) through highly insulating nanocapillary foils of polyethylene teraphthalate (PET). The observed phenomenon offered new possibilities for fundamental investigations, characterization of the inner walls of the insulating nanotubes and different applications. Using the electrons as projectiles gives new possibilities both for a fundamental understanding of the guiding phenomenon and applications. However, only recently the first results on guided transmission of electrons through insulating nanocapillaries have been reported for 200-350 eV through Al_2O_3 [2] and 500 and 1000 eV through PET [3].

This work could be also interesting in the frame of the ECCL WG2, considering both a fundamental understanding of different insulating materials and charging-discharging processes, as well as potential applications. The latter include a usage of nanocapillaries to produce micro-beams of low-energy electrons, spatially selective low-energy electron induced reactions on a surface, enhancement of electron-surface reactions using an array of nanochannels etc. According to our knowledge, the present work is the first to deal with guiding of electrons through insulating high aspect ratio nanocapillaries at low energies down to several eV.

/1/ Stolterfoht et al, Phys. Rev. Lett. **88**, 133201 (2002).
/2/ Milosavljevic et al, Phys. Rev. A, 72, 030901(R) (2007).
/3/ Das et al, Phys. Rev. A, 76, 042716 (2007).

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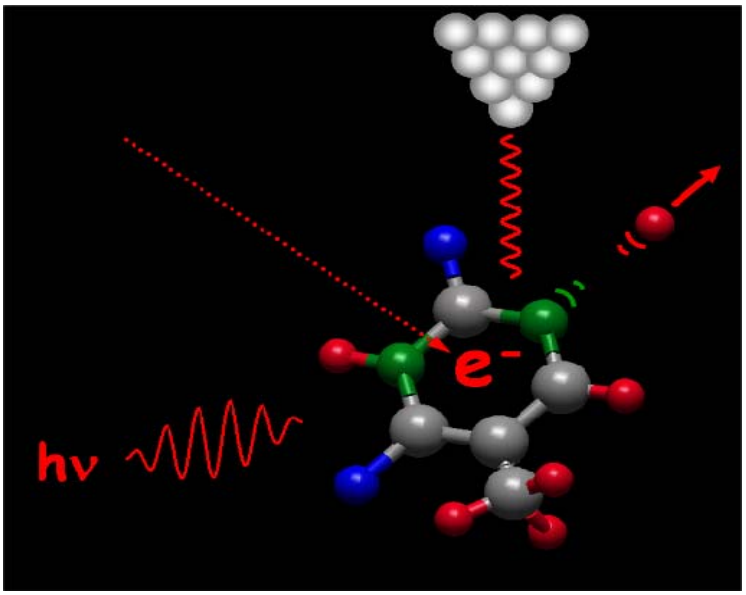

The precise control over chemical transformations, both in terms of 'tuning' reaction products and allowing site specific chemical control is the subject of one of the most exciting and rapidly developing areas of modern science - introducing the potential for the creation of new materials and the development of new technologies with dramatic implications for advances in such fields as nanotechnology, quantum electronics and biophysics. Related research is driven by the emergence of new experimental tools and techniques (e.g. ultrafast lasers, electron induced processing and scanning tunnelling microscopes) each of which may provide control of chemical reactions with high selectivity. The first method uses laser pulses with a duration of a few femtoseconds, the timescale on which the atoms in a molecule move, to manipulate molecular wavepackets and control dissociation pathways; the second uses very low energy electrons to dissociate the molecular target at well defined reaction sites while the third methodology uses scanning tunnelling microscopes to manipulate single molecules absorbed on surfaces. Together these three techniques offer the unique ability to select and 'tune' chemical pathways allowing us unprecedented control over chemical reactions.

This conference will bring together leading experts from the fields of *electron-*, *laser-*, and *plasma-driven* chemical processing. Despite their common goals and synergies between the different approaches (e.g in understanding molecular dissociation dynamics and fragmentation patterns) *this is the first time in any international research forum that the different communities exploring routes to chemical control will be brought together at a single dedicated research conference.* The aim of this meeting is therefore to (i) promote the awareness of a common research basis and (ii) to discuss new opportunities and directions such as facile processes for surface functionalization and nanostructuring that may be developed through collaboration between the different communities. This will include not only research on fundamental aspects of molecular fragmentation and chemical control but also highlight the applications in the areas of surface, material science and the ability to extend such knowledge to the study of biomolecular systems (e.g. in development of DNA as a functional engineering material).

Sessions will focus on:

- Chemical Control using ultrashort light pulses
- Chemical Control using low-energy electrons
- Chemical Control at the nanoscale with STM
- Plasma processing and nanofabrication
- Chemical control of biomolecules

Chair: Petra Swiderek, Universität Bremen, DE

Invited Speakers will include

Michael Allan, Fribourg U., CH
Flemming Besenbacher, Aarhus Uni., DK
Peter H. Beton, Nottingham U., UK
Iwona Dabkowska, Gdansk U., PL
Sandro di Silvestri, Milan U., IT
Gerald Dujardin, Paris Sud U., FR
Ilya Fabrikant, Nebraska U., US
Olivier Faucher, Dijon U., FR
Katharina Francke, Free U. Berlin, DE
Gustav Gerber, Würzburg U., DE
Armin Gölzhäuser, Bielefeld U., DE
Angel Gonzalez-Urena, Universidad Complutense Madrid, ES
Jimena Gorfinkiel, Open U., UK
Michael A. Huels, Sherbrooke U., CA
Eugen Illenberger, Free U. Berlin, DE
Oddur Ingolfsson, Iceland U., IS
Andrey Kaplan, Birmingham U., UK
Anne Lafosse, Paris Sud U., FR
Toshiaki Makabe, Keio, JN
Karina Morgenstern, Hannover U., DE
Markus Motzkus, Marburg, DE
Roberto Otero, Autonoma U. Madrid, ES
Seiji Samukawa, Tohuku U., JN
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