SYFM 2: Quantum control of functional molecules II

Zeit: Mittwoch 16:30–18:30 Raum: 6C

Hauptvortrag SYFM 2.1 Mi 16:30 6C

Photochromic systems and *moving* molecules and nano-objects — •Luisa De Cola — Westfälische Wilhelms-Universität, Physikalisches Institut and CeNTech, Mendelstr. 7, 48149 Münster, Germany

In this contribution I will discuss the use of the photochromic behavior of metal complexes. In particular the possibility to switch on/off photoinduced processes (e.g., energy transfer) controlling the state of the photochromic unit will be illustrated [1]. The talk will then focus on the use of mesoporous materials for the entrapping of dyes and their release upon photoisomerization of azobenzene derivatives linked to the pores [2]. Finally it will be shown how zeolite L, biocompatible nano- microcontainers, upon functionalization can be non-covalently linked to living organisms [3]. The filled zeolite, with fluorescent dyes, will be used to monitor the motion of bacteria and their uptake by cells will be discussed.

[1] for a recent review see: P. Belser, L. De Cola, et al., Adv Funct Mat 2006, 16, 195.
[2] P. Sierocki, H. P. A. Maas, P. Dragut, G. Richardt, F. Vögtle, L. De Cola, F. A. M. Brouwer, J. I. Zink, J.Phys.Chem. B 2006, 110, 24390 and paper submitted.
[3] Z. Popovic, M. Otter, G. Calzaferri, S. Huber, L. De Cola, submitted

Hauptvortrag SYFM 2.2 Mi 17:00 6C

Mechanisms of electron induced switching at interfaces — •Martin Wolf — Fachbereich Physik, Freie Universität Berlin, 14195 Berlin

The possibility to design molecules with dedicated functional properties opens the perspective to use molecules as building blocks for integrated functional devices. However, for applications like in molecular electronics it will be essential to control the switching between different molecular states and to connect the molecular system with the outside world by contacts with electrodes. This requires the synthesis and design of appropriate nanosystems and a basic understanding of structural and electronic properties including the interaction with solid interfaces. In addition, one would like to achieve active control of the switching between different molecular conformations by external stimuli like electromagnetic fields, forces and currents. In this talk I will present the approach of the collaborative research center Sfb 658 "Elementary processes in molecular switches at surfaces" to this problem and discuss our current understanding using several examples for (reversible) conformational switching processes at surfaces induced by charge transfer, electrical fields, currents and light probed with scanning tunnelling microscopy and photoemission spectroscopy.

Hauptvortrag SYFM 2.3 Mi 17:30 6C

Physical mechanism of quantum control: ultrafast, robust and efficient by tailored intense resonant femtosecond laser pulses — •Matthias Wollenhaupt, Tim Bayer, Cristian Sarpe-Tudoran, and Thomas Baumert — Universität Kassel, Institut für Physik und CINSaT, Heinrich-Plett-Str. 40, D-34132 Kassel, Germany

The success of optimal control strategies in controlling chemical reaction dynamics with tailored light pulses is contrasted by our limited understanding of the underlying physical processes. However, new perspectives for quantum control of functional molecules open up due to the uncommon molecular dynamics induced by shaped resonant intense pulses. In this contribution the physical mechanism of quantum control using resonant ultrashort optimal pulses is investigated on model systems (atoms and small molecules [1,2]). Switching among different final electronic states is realized by Selective Population of Dressed States (SPODS). In the experiment high selectivity of the dressed state population (more than 90%) is demonstrated. Because we achieve tunability of dressed state energies in the range of several hundred meV, our approach is attractive for control of functional molecules. SPODS proceeds within a few optical cycles. Therefore our strategy might be operative in the presence of decoherence processes as well. Our approach is general, because resonant control scenarios - as demonstrated here - will become increasingly important as shorter and shorter pulses with ultra broad spectra are available.

[1] M. Wollenhaupt et al., Chem Phys Lett 419, 184(2006).
[2] M. Wollenhaupt and T. Baumert, J Photochem Photobiol A 180, 248 (2006).

Hauptvortrag SYFM 2.4 Mi 18:00 6C

Quantum control of electric ring currents by circularly polarized laser pulses — •Jörn Manz and Ingo Barth — Freie Universität Berlin, Institut für Chemie und Biochemie, Takustr. 3, 14195 Berlin

Few cycle laser pulses with durations from several hundred as to few fs may induce electronic excitations of valence electrons in oriented molecules, atoms, or ions. In particular, circularly polarized laser pulses may induce electron circulation or electric ring currents and induced magnetic fields in ring-shaped molecules such as Mg-porhpyrin, around linear molecules such as AlCl, or atoms. These ring currents are more than hundred times stronger than traditional ones induced by permanent magnetic fields. Moreover, the laser pulses allow active control, i.e. they may serve as "traffic light"for electronic pathways along alternative molecular bonds in ring-shaped molecules. Furthermore, analytic expressions derived for the non-relativistic H-atom and for one-electron ions show that electrons in $2p_+$ or $2p_-$ atomic orbitals have the strongest electric ring currents and the strongest magnetic fields. The LCAO-MO method can be applied in order to estimate approximate values of the ring currents and induced magnetic fields in molecules, based on the analytical formulas for atomic orbitals.

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