INSTITUT DE PHYSIQUE ET CHIMIE DES MATERIAUX DE STRASBOURG
23, rue du Loess – BP 43
67034 STRASBOURG CEDEX 02
☎ 03 88 10 71 41

SEMINAIRE IPCMS

MINISYMPOSIUM:
Ultrafast molecular dynamics in condensed phase

Prof. Giulio Cerullo

Dipartimento di Fisica, Politecnico Di Milano, Italy :

«Probing primary photoinduced processes in organic molecules with tunable few-optical-cycle light pulses »

&

Prof. Eric Collet

Institut de Physique de Rennes, France :

« New light on crystals: photoinduced phase transition and ultrafast structural dynamics probed by time-resolved X-ray diffraction and optical spectroscopy »

Jeudi 30 septembre 2010
10h30 - 12h30
Auditorium de l'IPCMS

Résumés au dos

Pour rencontrer les conférenciers veuillez prendre contact avec Jérémie Léonard par mél: Jeremie.Leonard@ipcms.u-strasbg.fr

10h30-11h30 : *Probing primary photoinduced processes in organic molecules with tunable few-optical-cycle light pulses*

Giulio Cerullo
Dipartimento di Fisica, Politecnico Di Milano
P.za L. da Vinci 32, 20133 Milano, Italy
giulio.cerullo@fisi.polimi.it

Many light-induced processes in organic molecules, such as energy relaxation, energy/charge transfer and conformational changes, occur on ultrafast timescales, ranging from 10^{-14} to 10^{-13} s. The speed of such elementary processes is intimately linked to their efficiency, making ultrafast optical spectroscopy an invaluable tool for their investigation. Pump-probe spectroscopy requires both short pulses, in order to observe fast dynamics, and broad frequency tunability, to excite a system on resonance and probe optical transitions occurring at different frequencies. Optical parametric amplifiers (OPAs) are ideal tools for such experiments, because they provide frequency tunability and support broad gain bandwidths, enabling the generation of very short pulses.

In this talk we will describe a state of the art system, based on two synchronized OPAs, providing sub-10-fs temporal resolution over a very broad spectral range, from 400 nm to 2 μm. After reviewing the pulse generation techniques and the system performance, we will present selected examples of applications to the study of ultrafast processes, such as: energy transfer in photosynthetic light harvesting complexes, electronic and vibrational dynamics in carbon nanotubes, isomerization of rhodopsin.

11h30-12h30 : ***New light on crystals: photoinduced phase transition and ultrafast structural dynamics probed by time-resolved X-ray diffraction and optical spectroscopy***

E. Collet, M. Lorenc, M. Buron, M. Servol , H. Cailleau
Institut de Physique de Rennes, University Rennes 1, Rennes 35042, Rennes
eric.collet@univ-rennes1.fr

Light may direct the functionality of a material through spectacular collective and/or cooperative photoinduced phenomena in the solid state. This can trigger the transformation of the material towards another macroscopic state of different electronic and/or structural order, for instance from non magnetic to magnetic, from insulator to conductor, from paraelectric to ferroelectric [1]. This addresses long-lived instabilities generated by cw laser excitation, as well as pulsed light driven transformations.

On the one hand, cw light excitation can switch molecular states, through the trapping of the electronic state with structural reorganization. For some systems the live-time of the transient photoinduced state easily span over days and for some systems light makes it possible to reach states which can not be observed in normal thermal equilibrium conditions [2].

On the other hand, pulsed laser excitation can generate ultra-fast switching. The increase of sophisticated instrumentation, including ultra-fast time-resolved diffraction [3], gives fascinating capabilities not only to observe and understand the elementary dynamic processes in materials but also to watch how matter works and can be directed to a desired outcome. The key point is that in the solid state different degrees of freedom of different nature play their part on different time scales and the pathway is complex, from the molecular to material length and time scales. The discussion will be based on recent investigations [4,5] of the structural dynamics in molecular materials.

References

1. E. Collet et al, *Science* **300**, 612 (2003).
2. N. Brefuel et al, *Ang. Chem. Int. Ed.*, **48**, 9304-9307 (2003).
3. E. Collet *Guest Editor "Dynamical structural science" Acta Cryst. A.* **66** (2010)
4. M. Lorenc et al, *Phys. Rev. Lett.* **103**, 028301 (2009)
5. H. Cailleau et al, *Acta Cryst. A.* **66**, 189-197 (2010)