

## Ultrafast Spectroscopy of Molecular Semiconductors

M. Saba, F. Quochi, A. Gocalinska A. Mura and G. Bongiovanni

Dipartimento di Fisica, Università di Cagliari, Italy

<http://www.dsf.unica.it/~fotonica>

**Research overview.** Basic research on the electronic and optical response of materials provides the scientific platform for the development of novel and advanced photonic devices. Our interest focuses on the optical properties of organic and hybrid systems, particularly nanoaggregates and nanostructured materials. We customize spectroscopic tools to investigate light-matter interaction with sub-micron spatial resolution and on femtosecond time-scales.

**Laboratories.** Among the facilities equipping our labs are:

Femtosecond lasers: Ti:Sa oscillator, regenerative amplifier, parametric oscillators (200nm-10000nm)

Two-color femtosecond pump-probe set-up

Time-resolved luminescence with 2ps-resolution streak camera

Diamond Anvil cell for high-pressure spectroscopy (100GPa)

Confocal optical microscope coupled with streak camera

Sample preparation facility: glove boxes, evaporation, dielectric sputtering, spin coating, photolithography

### Recent Experiments

*Lasing in p-6p nanofibers.* Lasing in the monomolecular regime has been demonstrated in self-assembled nanofiber oligophenyl films with high carrier mobility. Effects of intermolecular interactions on lasing threshold are tuned by lattice temperature. Comparison of lasing threshold under femtosecond and nanosecond optical pumping highlights the advantageous scaling in the monomolecular regime. [F. Cordella et al., *Advanced Materials* 19, 2252 (2007), F. Quochi et al., *Advanced Functional Materials*, submitted (2007)]

*Charge transfer in colloidal nanocrystals.* Colloidal quantum dots in organic matrices are a popular choice for photovoltaics, given their tuneable optical absorption and simple fabrication. One crucial step is charge separation after optical absorption. We study the time needed to transfer photoexcited electrons from quantum dots into organic matrices acting as electron acceptors. PbS quantum dots with different passivation layers were employed. Time-resolved quantum dot luminescence measures the shortening of the luminescence decay due to charge transfer. Photocurrent measurements are confirming that luminescence quenching was indeed linked to separation of excitons into free charges.