



Contribution ID: 178

Type: **Contributed talk**

Excitation Energy Transfer and Diffusion in Synthetic Light-Harvesting Nanoparticles

Thursday, June 26, 2025 3:20 PM (20 minutes)

We investigate electronic excitation energy transport within 40-nm organic nanoparticles (ONPs) loaded with cationic rhodamine dyes (R18). Bulky counterions act as spacers which prevent dyes aggregation and quenching, up to dye concentrations as large as 300 mM - i.e. ~ 1 nm inter-dye distance - and similar to the effective dye concentration in natural, photosynthetic light-harvesting antennas. In this disordered, rigid solution of dyes, the inter-dye interaction remains relatively weak suggesting an incoherent energy hopping mechanism within the dyes.

We implement femtosecond fluorescence up-conversion spectroscopy to monitor the ultrafast fluorescence anisotropy decay of the ONPs dispersed in water solution. Hopping times as fast as 90 fs are obtained. Alternatively, we use a streak camera to monitor the nanoparticles fluorescence decay kinetics due to exciton-exciton annihilation (1) or to energy transfer to a few energy acceptors (traps) embedded within the ONPs. All three types of experiments provide indirect measurements of the exciton diffusion constant and consistently reveal a diffusion length of 80 to 120 nm - i.e. longer than the particles' diameter. These results rationalize the remarkable "antenna effect" already reported for the nanoparticles, which are applied to bio-sensing and single molecule detection.(2)

(1) Gharbi, A. M.; Biswas, D. S.; Crégut, O.; Malý, P.; Didier, P.; Klymchenko, A.; Léonard, J. Exciton Annihilation and Diffusion Length in Disordered Multichromophoric Nanoparticles. *Nanoscale* 2024, 16 (24), 11550–11563. <https://doi.org/10.1039/D4NR00325J>.

(2) Trofymchuk, K.; Reisch, A.; Didier, P.; Frasn, F.; Gilliot, P.; Mely, Y.; Klymchenko, A. S. Giant Light-Harvesting Nanoantenna for Single-Molecule Detection in Ambient Light. *Nature Photonics* 2017, 11 (10), 657–663. <https://doi.org/10.1038/s41566-017-0001-7>.

Author: LÉONARD, Jérémie (Université de Strasbourg & CNRS, IPCMS, UMR 7504, F-67200 Strasbourg, France.)

Co-authors: GHARBI, Amira Mounya (Université de Strasbourg & CNRS, IPCMS, UMR 7504, F-67200 Strasbourg, France.); KLYMCHENKO, Andrey (Université de Strasbourg, Faculté de Pharmacie, LBP, UMR 7021, F-67400, Illkirch, France); BISWAS, Deep Sekhar (Université de Strasbourg, Faculté de Pharmacie, LBP, UMR 7021, F-67400, Illkirch, France); CRÉGUT, Olivier (Université de Strasbourg & CNRS, IPCMS, UMR 7504, F-67200 Strasbourg, France.); DIDIER, Pascal (Université de Strasbourg, Faculté de Pharmacie, LBP, UMR 7021, F-67400, Illkirch, France)

Presenter: LÉONARD, Jérémie (Université de Strasbourg & CNRS, IPCMS, UMR 7504, F-67200 Strasbourg, France.)

Session Classification: Session 13 - Materials I