Controlled switching of fluorescent polymer nanoparticles through energy transfer

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Among the variety of nanomaterials for bioimaging applications dye-loaded polymer nanoparticles (NPs) attract currently great attention due to their organic nature, easy preparation protocols and available methods for controlling surface properties. [1] Addition of bulky counterions [2] has allowed to minimize aggregation caused quenching (ACQ) at high dye loading and to obtain ultrabright NPs. Mastering of excitation energy transfer (EET) would give the opportunity to control blinking of NPs and their application as efficient energy donors in FRET. We demonstrate here a simple way of tuning EET among encapsulated dyes (rhodamine salt R18/F5-TPB) by controlling their organization during nanoprecipitation with the host polymer matrix (Fig. 1). Indeed, by changing hydrophobicity of the polymer matrix and dye loading, we could obtain particles featuring continuous emission, complete ON/OFF switching or partial blinking (Fig. 1). Exploiting EET also enabled to design NPs with amplified photoswitching through FRET,[3] as well as NPs with strong light harvesting effects. The obtained results are of particular interest for development of nanoscale sensors as well as NPs for super-resolution imaging and tracking with superior signal-to noise ratio.

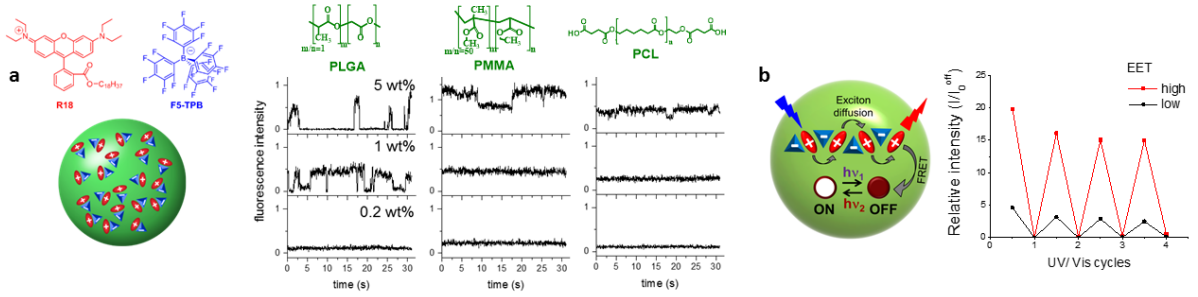

Figure 1. a) Structures of rhodamine B octadecyl ester (R18) and its counterion tetrakis(pentafluorophenyl)borate (F5-TPB), schematic representation of a dye-loaded polymer NPs and single particle transients of NPs made from different polymers with different amounts of R18/F5-TPB. b) Schematic presentation of the photoswitching concept in dye-doped NPs and photoswitching of fluorescent NPs with high and low EET.

Funding: European Research Council (ERC) Consolidator Grant BrightSens 648528. Ministry of Higher Education and Research of France

References:

[1] A. Reisch, A.S. Klymchenko, *Small,* **2016**, 12,1968-92
[2] A. Reisch, P. Didier, L. Richert, S. Oncul, Y. Arntz, Y. Mély, A.S. Klymchenko, *Nat*

Commun. **2014**, 9, 4089
[3] K. Trofymchuk, L. Prodi,A. Reisch, Y. Mely, K. Altenhoener, J. Mattay, A.S. Klymchenko, *J.Phys.Chem.Lett*, **2015** 6, 2259