MACROSCOPIC AND MICROSCOPIC COLOR-TUNING OF SELF-ASSEMBLED DIALKOXY-DIPHENYLANTHRACENE NANO-RIBBONS

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Fluorescent organogels and 1D-organic nano-objects have gained enormous interest in last decades for their potential use in optoelectronics[1]. Self-assembled nano-fibers[2] or nano-ribbons from anthracene derivatives are an interesting matrix for color-tuning of fluorescence, light-harvesting and the study of the photophysical processes involving guest tetracene derivatives.

Nano-ribbons from pure 2,3-dihexadecyloxy-9,10-diphenylanthracene (DPA-C16) emit blue light, but the emission color can be tuned and turned into green by doping with 1% 2,3-dihexadecyloxy-5,12-diphenyltetracene (DPT-C16). The optical properties of these two components provide the preconditions for two-color-writing in single nano-objects. The green-emitting DPT-C16 acts as an energy-acceptor of the DPA-C16-donor-matrix, thereby quenching nearly 100% of the blue fluorescence of the ribbons via combined exciton-hopping and Förster type energy transfer (ET). In the presence of ambient oxygen and adequate excitation power focused on a small volume of a ribbon the acceptor photo-degrades. This induces the lapse of green emission and awakens the blue emission due to the disappearance of the energy transfer, thus enabling simultaneous negative and positive writing. The robustness of the energy-donor under laser excitation guarantees the activation of fluorescence in the blue, rather than a more common laser-induced photo-bleaching of both donor and acceptor. The control of the advancement of the bleaching process also allows a control at the micrometer scale of the color of the emission on different segments of the ribbon (see CIE coordinates in Figure c).

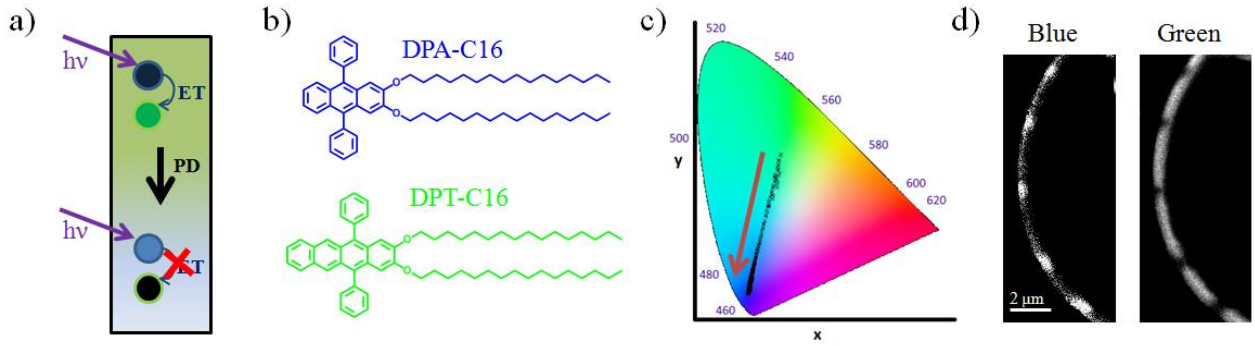

Figure: a) Schematic of two-color-patterning by amplified photo-degradation (PD) via efficient energy transfer (ET). b) Molecular structure of the donor-molecule DPA-C16 which can self-assemble forming nano-ribbons and molecular structure of the acceptor-molecule DPT-C16. c) Color change during the writing-process in the CIE-color-space. d) Blue and green emission of a photo-patterned ribbon.

Our studies reveal that indirect photo-patterning via energy transfer leads to better contrast than by direct excitation of the acceptor. Polarization microscopy shows that this selective and local photo-degradation does not alter the molecular packing in the ribbons. This study corresponds to a first example of local manipulation of optical properties to form 1D-heterostructures of *n*-acene-based nano-ribbons.

[1] Zhao Y.S.; Fu H.; Peng A.; Ma Y.; Liao Q.; Yao J. *Acc. Chem. Res.* **2010**, *43*, 409-418.
[2] Giansante, C.; Raffy, G.; Schäfer, C.; Rahma, H.; Kao, M.-T.; Olive, A. G. L.; Del Guerzo, A. *J. Am. Chem. Soc.* **2011,** *133*, 316-325.