

A scanning probe view on the photoreactivity of all-organic Core@Shell Nanoparticles: the effect of photoinduced charge separation from enhanced neuronal photostimulation to in vivo tunable ROS production

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Thiophene-based core@shell nanoparticles are characterized by a core made of P3HT polymer, surrounded by its oxydized form, namely P3HT@PTDO NPs. Photo chemical and physical characterizations show that such nanoarchitecture results in a quite unique all-organic type II interface, which, in addition to the soft and biocompatible nature, makes the material a promising platform of a variety of applications, particularly in biological fields.

Here, using scanning probe techniques and, more specifically, an extensive use of microscopic and macroscopic Kelvin Force Probe (KPFM and KP), we demonstrate that the surface of core@shell NPs becomes rich in negative charges under light illumination, due to the promotion of photogenerated electrons from the inner P3HT core to the outer oxidized PTDO shell, making them more reactive to the environment (air dopants, water, substrate, etc...).

Combing our results with complementary analysis -including time-resolved photoluminescence (TRPL), femtosecond transient absorption (TA) and electron paramagnetic resonance (EPR)- we show that such peculiar photoreactivity properties can be exploited for: i) efficient photostimulation of retinal neurons[1] and ii) the modulation of ROS generation depending on the shell's oxygenation degree, both in vitro and in vivo[2].

References

- [1] J. Barsotti et al., ACS Appl. Mater. Interfaces 15 (2023), 13472–13483
- [2] M. Zangoli et al., J. Phys. Chem. C, 127 (2023), 4672–4683