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Quantum nanostructures for charge separation at the biological interface

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Living cells photostimulation can be achieved exploiting different physical mechanisms such as chemical reaction, current injection, capacitive coupling and thermal effect. Each mechanism can be ascribed to a specific material or a particular geometry *[1]*. Here we focused the attention on this physical phenomena taking place at the biotic/abiotic interface analyzing the interaction between living cells and light-sensitive organic polymers.

In particular, we evaluate the effect of the Poly(3-hexylthiophene) (P3HT) nanoparticles due to their relevant role as functional materials for the development of advanced biophotonic systems. We already demonstrated that blind laboratory rats treated with P3HT nanoparticles were able to recover vision highlighting the potential biomedical applications in the context of neuronal stimulation and neuroprostheses [2].

Within this context we exploit different approaches to enhanance the charge separation at the biotic/abiotic interface in order to maximize the role of the capacitive effect. In particular we play on nanostructured thiophene-based core@shell nanoparticles.[3] We realized the core-shell geometry exploiting an oxidation process leading to nanoparticles with a P3HT core and an oxygenated P3HT (PTDO) shell. This structure were proven as highly effective photon nanotransducers and here we provide a detailed photophysical picture in accordance with the morphology and the internal features of the nanostructures, engineered to support long-lived charge separation.

References

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