Photoinduced effects in flatland

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In recent years, a plethora of material systems have been designed and prepared to increase the performance of light harvesting and light-emitting technologies, and to develop new and attractive applications. Limitations of state-of-the-art devices based on organics (both conjugated polymers or small molecules/oligomers) derive largely from material stability issues after prolonged operation. This challenge could be tackled by leveraging the enhanced stability of carbon nanostructures (CNSs, including carbon nanotubes and the large family of graphene-based materials) in carefully designed nano-hybrid or nano-composite architectures to be integrated within photo-active layers, paving the way to the exploitation of these materials in contexts in which their potential has not been yet fully revealed [1]. In this talk, I will discuss the theoretical background behind CNSs hybridization with other low dimensional materials, focusing on different assemblies: 0D/0D considering graphene carbon dots and small molecules [2-4], as well as 0D/2D assemblies [5], in which we can follow the evolution of both charge and energy transfer, providing an overview of new optoelectronic and transfer properties arising from the assembly of low dimensional materials, that allow to forecast interesting future perspectives for use in real devices and molecular physics and chemistry, opening up new research directions and opportunities for collaboration.

REFERENCES

[1] Osella S., Wang M., Menna E., Gatti T. *Optical Materials: X* **12**, 100100 (2021)
[2] Kaźmierczak M., Trzaskowski B., Osella S. *Int. J. Mol. Sci.* **23**, 543 (2022)
[3] Kaźmierczak M., Giannini S., Osella S. *J. Mat. Chem. C* **12**,143-153 (2024)
[4] Langer M., Zdražil L., Rogach A. L., Osella S., Otyepka M. *Carbon* **2026**, *249,* 121228.
[5] Wlazło M., Langer M., Semchuk O., Osella S. *Theor. Chem. Acc*. **2025**, *144,* 14.