Promising artificial one-directional antenna system based on cyanine-doped hybrid material

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Although antenna systems can be found in nature, such as those responsible for photosynthesis processes, the synthesis and design of artificial antenna systems is not an easy task. The key factor is the mimicry of light-harvesting and sequential transfer that takes place in natural antenna systems, involving donor and acceptor molecules, usually chromophores [1]. In this work, artificial antenna systems consisting on different chromophores or different species of the same chromophore, in situ encapsulated into 1-D nanochannelled magnesium-aluminophosphates (MgAPOs) are synthesized and characterized. Through the crystallization inclusion method approach, the encapsulation of the dyes is not only performed in a unique step, but also a strategic distribution of the dye species along the nanochannells of the host is achieved (Figure 1), enabling one-directional Fösters Resonance Energy Transfer processes between dyes or dye species absorbing and emitting light in different ranges of the electromagnetic spectrum. In this work, different hybrid materials are presented, prepared following this strategy, beginning with particles doped with pyronin Y (PY) and/or acridine (AC) [2,3], and reaching more efficient and long-range antennas incorporating a cyanine dye (PIC), appealing due to the intriguing properties of its J-aggregates [4]. The energy transfer in these materials has now been experimentally evidenced by remote excitation microscopy technique, resulting in the last case in an energy transfer reaching over tens of microns (Figure 2) [4].

References

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[4] Sola-Llano, R.; Fujita Y.; Gómez-Hortigüela, L.; Alfayate, A.; Uji-I, H.; Fron, E.; Toyouchi, S.; Pérez-Pariente, J.; López-Arbeloa, I.; Martínez-Martínez, V., ACS Photonics, 5 (2018) 151.

Figures

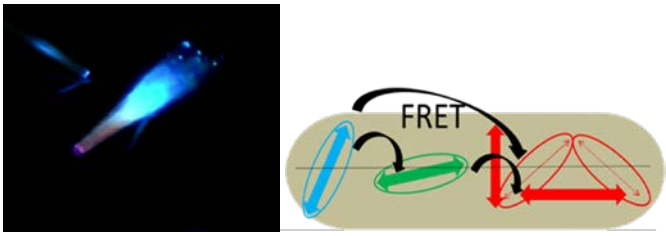

Figure 1: Left: fluorescence image of an AC/PY doped MgAPO-36 needle bouquet under UV excitation light. Right: Scheme of the energy transfer taking place in the system.

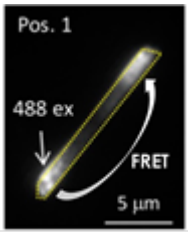

Figure 2: Fluorescence intensity image of a PIC/MgAPO-36 particle. 488 nm excitation was fixed at position pointed with an arrow.