

Development of nanostructured host-guest hybrid material for Non-Linear Optics

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One approach to achieve photoactive hybrid materials with interesting properties for optical applications consists on the encapsulation of organic fluorophores into rigid inorganic frameworks. In this sense, it has been demonstrated that MgAPO-11, a magnesium aluminophosphate with AEL structure and 1-D nanochannels, is a suitable host to guest dyes with a general molecular structure built up by three fused aromatic rings since it prevents dye aggregation due to its tight pores (6.5 Å x 4 Å) with special topology, consisting on pockets.[1,2] Also due to the narrow size of the channels, the incorporation of the dyes should be carried out by crystallization inclusion method instead of by the typical post-synthetic approaches since diffusional process is impeded.

In order to find new nanostructured materials with applicability in the field of non-linear optics, a dye with intrinsic non-linear optical properties was chosen to be occluded into the MgAPO-11 matrix, the LDS 722. Although the synthesis of this type of dye-loaded MgAPOs is rather straightforward, an optimization of the synthetic procedure was required for the incorporation of this dye. Finally, the result was pure LDS722/AEL material which shows enhanced fluorescence capacity in comparison with the dye in solution (ϕ_{fl} (dye in aqueous solution) \sim 0.01 vs. ϕ_{fl} (LDS722/AEL) = 0.55) and highly anisotropic response to the linearly polarized light due to the preferential alignment of the dyes within the tight pores. As a result, this material revealed attractive second-order non-linear properties such as Second Harmonic Generation (SHG) under NIR irradiation, proven through microscopic techniques at single crystal level. [3]

References

- [1] Virginia Martínez-Martínez, Raquel García, Luis Gómez-Hortigüela, Joaquín Pérez-Pariente, Iñigo López-Arbeloa, Chem. Eur. J., 19 (2013) 9859.
- [2] Virginia Martínez-Martínez, Raquel García, Luis Gómez-Hortigüela, Rebeca Sola-Llano, Joaquín Pérez-Pariente, Iñigo López-Arbeloa, ACS Photonics, 1 (2014) 205.
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Figures

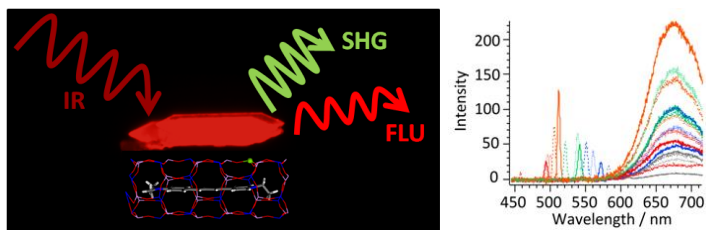


Figure 1: Left: Fluorescence image of a LDS722/AEL crystal with an illustration of the processes arising under NIR illumination. A representation of the LDS 722 molecule within an AEL channel is also shown (down). Right: SHG/Fluorescence spectra of a LDS722/AEL single particle upon different excitation wavelengths from 812 to 1222 nm.