

Host-guest nanostructured materials for photonic applications

Motivation

Incorporation of organic molecules into nanoporous crystal hosts represents a viable strategy towards spatially and orientationally ordered, highly packed organic molecular aggregates for controlling:

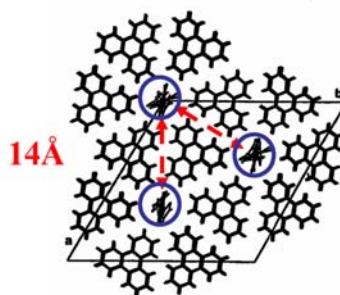
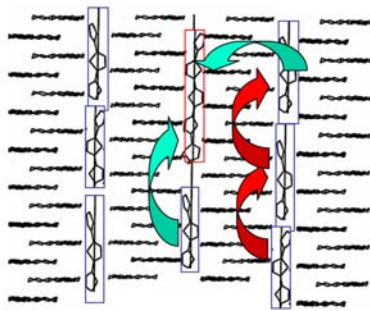
- light-matter interaction in absorption (*light harvesting*)
- *energy transfer*
- *cooperative radiative emission*

Functionalization of the end-terminal (*stop-cock*) guest molecules in nanoporous host crystals can also be exploited to produce *charge separation* at the interface with inorganic surfaces

→ *Potential for advanced photonic devices such as high-gain photonic antennae, wavelength converters, and tunable lasers at the microscale*

Different host-guest strategies

- *hybrid systems* like dye-loaded zeolite crystals [1]
- *all-organic materials*, such as inclusion compounds based on perhydrotriphenylene (PHTP) [2]



Two different types of dyes are inserted into the nanochannels of PHTP. Arrows in left panel indicate radiationless energy transfer (red: homotransfer; turquoise: heterotransfer). Right panel: top view

Experimental assessments

- radiationless energy transfer in various host-guest systems [3] including our recent report on cascaded energy transfer in PHTP-based inclusion compounds with three different dyes [4]
- lasing action in dye-loaded zeolite microcrystals [5]

[1] G. Calzaferri, S. Huber, H. Maas, and C. Minkowski, *Angew. Chem. Int. Ed.* **42**, 3732 (2003)

[2] G. Bongiovanni, C. Botta, G. Di Silvestro, M. A. Loi, A. Mura, and R. Tubino, *Chem. Phys. Lett.* **345**, 386 (2001)

[3] M. M. Yatskou, M. Meyer, S. Huber, M. Pfenniger, and G. Calzaferri, *ChemPhysChem* **6**, 567 (2003)

[4] C. Botta, G. Patrinoiu, P. Picouet, S. Yunus, J.E. Communal, F. Cordella, F. Quochi, A. Mura, G. Bongiovanni, M. Pasini, S. Destri, and G. Di Silvestro, *Adv. Mater.* **16**, 1716 (2004)

[5] U. Vietze, O. Krauß, F. Laeri, G. Ihlein, F. Schüth, B. Limburg, and M. Abraham, *Phys. Rev. Lett.* **81**, 4628 (1998)