Photonic Antenna System
for Light Harvesting, Transport and Trapping

Gion Calzaferri, Stefan Huber, Huub Maas
Department of Chemistry and Biochemistry, University of Berne, Freiestrasse 3, CH-3012 Berne (gion.calzaferri@iac.unibe.ch)

Host-guest composites with photonic antenna properties are described.[1-5] The material consists of cylindrical zeolite L crystals the channels of which are filled with chains of joined but electronically non interacting dye molecules. Light shining on a crystal is first absorbed and the energy is then transported by the dye molecules inside the tubes to the desired part. Data on crystals in the size range of 30 nm up to 3000 nm are reported. The synthesis principle we are using is based on the fact that molecules can diffuse into individual channels. This means that given the appropriate conditions, they can also leave the zeolite by the same way. In some cases, however, it is desirable to block their way out, for stability reasons. This is done by adding a closure molecule. The general approach to connect the antenna function to its surroundings is to add "stopcock" molecules which generally contain of a head, a spacer and a label. They can either trap excitation energy on the external surface or inject excitation energy into the dye-loaded crystal. The stopcock molecules act as a bridge between the dye molecules inside the channels and the outside world.[6] Functionalisation of the closure and the stopcock molecules is an option for tuning e.g. wettability, refractive index, and chemical reactivity. - The wide-ranging tunability of the dye-zeolite L composites makes them useful for many applications. We report encouriging results on a new type of solar cells based on an idea proposed by Dexter. He described sensitisation of the semiconductor by energy transfer instead of electron injection, followed by the production of an electron-hole pair in the semiconductor. Although Dexter published this idea in 1979, (D.L. Dexter, J. Lumin. 1979, 18/19, 779) only few groups have tried to observe energy transfer from a dye to a semiconductor so far. We have been successful.

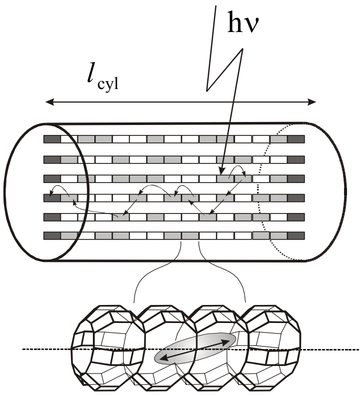

Figure 1: Representation of a cylindrical nano crystal consisting of organized dye molecules acting as donors (light gray rectangles) and an acceptor acting as trap at the front and the back of each channel (dark gray rectangles).[1,2,4,7] The enlargement shows a detail of the zeolite L channel with a dye molecule and its electronic transition moment, the orientation of which with respect to the long axis depends on the length and shape of the molecules.[1,3,7]

[1] G. Calzaferri, M. Pauchard, H. Maas, S. Huber, A. Khatyr, T. Schaafsma, *J. Mater. Chem*, **2002**, *12*, 1-13.
[2] M. Pauchard, A. Devaux, G. Calzaferri, *Chem. Eur. J.* **2000**, *6*, 3456.
[3] S. Megelski, A. Lieb, M. Pauchard, A. Drechsler, S. Glaus, C. Debus, A.J. Meixner, D. Calzaferri, *J. Phys. Chem B* **2001**, *105*, 25.
[4] M. Pauchard, S. Huber, R. Méallet-Renault, H. Maas, R. Pansu, G. Calzaferri, *Angew. Chem. Int. Ed*. **2001**, *40*, 2839-2842.
[5] S. Megelski, G. Calzaferri, *Adv. Func. Mater.* **2001**, *11*, 277-286.
[6] H. Maas, G. Calzaferri, *Angew. Chem. Int. Ed.* **2002**, 41, 2284.
[7] G. Calzaferri, H. Maas, M. Pauchard, M. Pfenniger, S. Megelski, A. Devaux, *Advances in Photochemistry*, Wiley & Sons, Vol 27, **2002**, p. 1-50.