Mimicking the antenna system of green plants

by supramolecular organization of dyes in nanochannels

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We discuss artificial antenna systems that are built by incorporating chromophores into the one-dimensional (1D) nanochannels of zeolite L (ZL) and by organizing the latter in specific ways. ZL is an excellent host for the supramolecular organization of different kind of molecules and complexes. The range of possibilities for filling its 1D-channels with suitable guests has been shown to be much larger than one might expect. Geometric constraints imposed by the host structure lead to supramolecular organization of the guests. The arrangement of dyes inside the ZL channels is what we call the first stage of organization. It allows light harvesting within the volume of a dye-loaded ZL crystal and the radiationless transport of electronic excitation energy to a well positioned acceptor. Quasi 1D-FRET transport can be realized in these guest-host composites. The second stage of organization is realized by coupling either an external acceptor or donor stopcock fluorophore at the ends of the ZL channels, which can then trap or inject electronic excitation energy. The third stage of organization is obtained by interfacing the composites to an external device via a stopcock intermediate. A possibility to achieve higher levels of organization is by controlled assembly of the composites into ordered structures. The usually strong light scattering of ZL can be suppressed by refractive index matching and avoidance of micro phase separation.
The concepts are explained in detail on a bidirectional dye antenna. Experimental results of composites with large donor to acceptor ratio and also three dye systems are used to illustrate validity and challenges of this approach. Applications are discussed, with special emphases on possibilities for solving old standing problems in luminescent solar concentrators.

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