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Photonics meets excitonics: Natural and artificial molecular aggregates

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Abstract

© 2013 Science Wise Publishing. Organic molecules store the energy of absorbed light in the form of charge-neutral molecular excitations - Frenkel excitons. Usually, in amorphous organic materials, excitons are viewed as quasiparticles, localized on single molecules, which diffuse randomly through the structure. However, the picture of incoherent hopping is not applicable to some classes of molecular aggregates - assemblies of molecules that have strong near-field interaction between electronic excitations in the individual subunits. Molecular aggregates can be found in nature, in photosynthetic complexes of plants and bacteria, and they can also be produced artificially in various forms including quasi-one dimensional chains, two-dimensional films, tubes, etc. In these structures light is absorbed collectively by many mole cules and the following dynamics of molecular excitation possesses coherent properties. This energy transfer mechanism, mediated by the coherent exciton dynamics, resembles the propagation of electromagnetic waves through a structured medium on the nanometer scale. The absorbed energy can be transferred resonantly over distances of hundreds of nanometers before exciton relaxation occurs. Furthermore, the spatial and energetic landscape of molecular aggregates can enable the funneling of the exciton energy to a small number of molecules either within or outside the aggregate. In this review we establish a bridge between the fields of photo nics and excitonics by describing the present understanding of exciton dynamics in molecular aggregates.

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Keywords

Exciton, Exciton dynamics, H-aggregates, J-aggregates, Light-harvesting complexes, Molecular aggregates