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Energy transfer between two light harvesting phthalocyanines derivatives as model for artificial photosynthetic antenna: Laser photolysis studies

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Energy transfer between two light harvesting phthalocyanines derivatives as model for artificial photosynthetic antenna: Laser photolysis studies

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Abstract: The singlet-singlet and triplet–triplet energy transfer studies between two light harvesting phthalocyanine derivatives namely, zinc tert-butyl phthalocyanine ZnTBPc, and zinc octabutyloxy phthalocyanine ZnOBuPc, have been investigated to mimic the efficient energy-transfer process among the chlorophyll units in the natural photosynthesis. Optical absorption and emission studies showed the strong absorption and fluorescence bands for ZnOBuPc in the NIR region, which are largely red-shifted compared to that of the ZnTBPc. The strong overlap between the emission spectrum of ZnTBPc and the absorption spectrum of ZnOBuPc in toluene suggests the occurrence of the energy transfer from the singlet ZnTBPc (1.80 eV) to the singlet ZnOBuPc (1.59 eV). From the time-resolved fluorescence technique, the rate of energy transfer process was found to be 6.79×10^7 s^{-1}. From the nanosecond laser photolysis measurements, the energy transfer from the triplet ZnTBPc to the lower lying triplet ZnOBuPc was clearly observed with a rate of 5.77×10^5 s^{-1}. These observations suggest the usefulness of the examined combination (ZnOBuPc / ZnTBPc) as a simple model for the artificial antenna in the photosynthetic systems.

Keywords: Phthalocyanines; energy transfer; artificial photosynthesis; laser photolysis.

1. Introduction

In recent years, there is a great interest in understanding the basic principles of the complicated natural photosynthesis process [1-3]. In this marvelous process, antenna absorbs solar light and transfers excitation energy to a photosynthetic reaction center, which generates a charge-separated state by electron transfer. Electrons transferred from the reaction center can reduce protons to H_2 at the proton reduction catalyst (PRC), whereas generated holes oxidize water to O_2 in water oxidation catalyst (WOC) .