Abstract:

Toxic singlet oxygen can be populated by the quenching of triplet states of chlorophyll (Chl). In photosynthetic light-harvesting complexes (LHCs), the generation of singlet oxygen is prevented by a photoprotective mechanism based on an energy transfer from Chl triplets to carotenoids, which occurs via a Dexter mechanism (DET). The temperature dependence of the DET was studied in three selected LHCs by means of transient absorption spectroscopy. The emphasis was on a chlorophyll *a*-chlorophyll c_2-peridinin-protein complex (acpPC) of *Dinoflagellate Amphidinium carterae*. The results obtained from acpPC were compared with those for LHC-II from pea and chlorosomes of *Chloroflexus aurantiacus*. All three antennas exhibit high efficiency and fast rate of chlorophyll triplet quenching by carotenoids at room temperature, which prevents the accumulation of Chl triplets. The fast rate of quenching persists at low temperatures ($\geq$77 K) in the case of LHC-II. However, the efficiency of the Chl triplets quenching is lower as proved by a detection of long-lived Chl triplets with a millisecond lifetime. These triplets were assigned to peripheral Chls that are not neighbouring with carotenoids active at 77 K. A similar population of long-lived Chl triplets was detected in the acpPC complex. In acpPC, the rate of the quenching by carotenoids is different in three subpopulations of carotenoids. The first subpopulation is ascribed to peridnin in a non-polar environment (or diadinoxanthin) and exhibits a high rate of DET independently of temperature. Two other subpopulations formed by peridinin in a polar and non-polar environment (or diadinoxanthin) show a strong temperature dependence with a more than 1000 times lower rate at 77 K compared to room temperature. Chlorosomes also exhibit the temperature dependence of the quenching rate by carotenoids. However, no long-lived bacteriochlorophyll triplets were detected.