P04

Concentration quenching in solutions of chlorophyll molecules

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Most of the organic fluorophores in low concentration solutions exhibit photoluminescence quantum yield (PLQY) close to 1. However, PLQY decreases with an increase concentration of the fluorophores [1]. This is a consequence of a phenomenon called concentration quenching (CQ). It is important to understand its mechanism of action, since CQ could have negative effects on many optoelectronic devices, such as: OLEDs [2], solar concentrators [3], etc. CQ phenomenon is particularly intriguing for organometallic compounds such as chlorophyll (Chl) due to its crucial role in photosynthesis. Chl molecules are tightly packed in photosynthetic complexes, however, CQ effect is much smaller than for the same Chl concentrations in solutions. Despite the importance of CQ, there is no clear model, that would in detail explain its mechanism.

The goal of this investigation was to examine CQ effects in chlorophyl-a (Chl-a) and chlorophyl-b (Chl-b) molecules in solvents of different polarities: dimethylsulfoxide (DMSO) and ethanol (EtOH). During the study absorption, fluorescence and fluorescence decay kinetics were measured.

For both Chl-a and Chl-b solutions, CQ is observed starting from 1 mM concentration;, for lower concentrations, no CQ is observed. For Chl solutions with increasing concentration, there is a decrease in intensity of the main fluorescence band (~670 nm for Chl-a and ~660 nm for Chl-b). For Chl-a in DMSO, new band formation between the main ~670 nm and ~730 nm peaks is observed. For Chl-a and Chl-b in EtOH, new bands are not visible, however, there are shifts to shorter wavelengths in absorption and fluorescence spectra for Chl-b solutions. For both Chl molecules, fluorescence decay kinetics clearly show CQ, with similar trend to the one shown in Fig. 1.

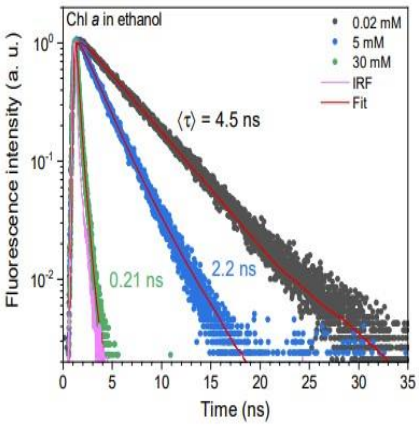

Fig. 1. CQ phenomenon: fluorescence decay kinetics with average lifetimes for different concentrations of Chl-a in EtOH.

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