An Ultrafast Study of Zinc Phthalocyanine in DMSO

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Abstract: The ultrafast dynamics of Zinc Phthalocyanine was studied using transient absorption pump probe spectroscopy. Zinc Phthalocyanine was excited (pumped) at 672nm and probed by a white light continuum. The pump-probe technique used in this study is described and experimental results obtained are discussed.

1. Introduction

Zinc phthalocyanine (ZnPc) is a promising photodynamic therapy (PDT) photosensitiser which has a relatively long triplet excited state lifetime of 350 μs [1,2] and has a strong absorption band in the optical transmission window for human tissue. After excitation from the singlet ground state to the singlet excited state, an inter-system crossing transition occurs from singlet to triplet state ($S_1 \rightarrow T_1$). This transition is thought to occur on ultrafast timescales [3]. In recent studies the presence of ultrafast dynamics occurring in ZnPc was confirmed although assignment of the components remains a challenge [3].

2. Results

A standard transient absorption pump probe spectroscopy technique was used and our experimental setup has been described in detail elsewhere [4]. Briefly, this consists of a tunable visible pump pulse of ~ 150 fs at 1 kHz and a delayed probe pulse. The probe pulse is sent to a variable optical delay line and then focused on a sapphire plate to generate a white light continuum. In this experiment, the pump was set to 672 nm (pulse energy 1-3 μJ). A steady state absorption spectrum of ZnPc in DMSO was acquired using a Xe-Kr lamp combined with USB2000 ocean optics spectrometer. A strong absorption peak near 672 nm was observed as expected - this can be explained as the transition from the singlet ground state to the first singlet excited state.

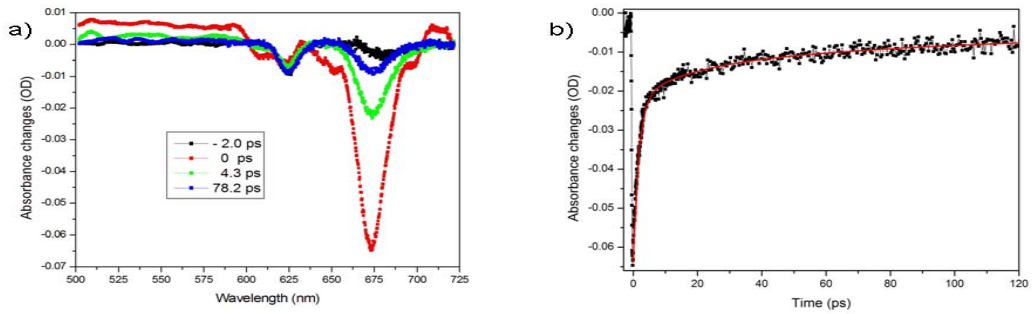

Figure 1: a) Transient absorption of ZnPc in DMSO in the indicated wavelength interval and time delays with the pump wavelength set at 672 nm. b) Absorbance changes as a function of relative delay time between pump and probe pulses for ZnPc in DMSO probe at 672 nm pumped at 672 nm.

The absorbance-change spectra at specific delay times are shown in Figure 1a. The absorbance change at a probe wavelength of 672 nm as a function of delay time is shown in Figure 2b. The results obtained in our experiment show a good fit to a bi-exponential decay at the 672 nm band peak, comprising a fast process with a time constant of 1.82 ± 0.06 ps and a slower process with a time constant of about 38.9 ± 2.6 ps attributed to internal conversion from S_1 to S_0. In addition we were able to resolve a mono-exponential fast process with a time constant of 2.7 ± 0.5 ps at 630 nm. This was attributed to solvation dynamics.

3. References

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