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Ultrafast excited state dynamics of tri-branched derivatives based on 1,3,5-triazine: Pumped with different power conditions

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ABSTRACT

Degenerate pump-probe experiment at wavelength of 400 nm, was performed to study the effect of the pump power condition on the excited state decay dynamics of tri-branched derivatives based on 1,3,5-triazine. These two styryl derivatives were dissolved in $CHCl_3$ solutions, and different pump power densities were selected for the research in degenerated pump-probe measurement. Obvious different excited state decay dynamics were obtained under two conditions. When a relative low pump power density is chosen, the two tri-branched compounds show three processes: an ultrafast process approximately sub-ps (was ascribed to the coherent artifacts), a fast process approximately several ps (was ascribed to the formation of the intramolecular charge transfer state), and a long process approximately several hundreds of ps (was ascribed to the evolution of the intramolecular charge transfer state), respectively. When a high pump power density is employed, these processes were accelerated obviously, indicating some other processes of different mechanism involved.

1. Introduction

Nonlinear optical materials that show excellent two-photon absorption (TPA) properties, have been a hot topic and was extensively investigated for promising applications in various fields, such as optical limiting, optical data storage, 3D microfabrication, two-photon fluorescence bioimaging, upconversion lasering and photodynamic therapy [1–6]. Design and synthesis of new functional material with adequate TPA property has been a hot research topic in various fields [7].

Excited state decay dynamics can provide great information on the excited states, which can assist in the design of new material with both large TPA cross-section and high fluorescence quantum yield. We investigated TPA cross-sections and ultrafast excited state decay dynamics of some organic dyes [8–14]. Our results have provided a better understanding on the excited states and have assisted the optimization of new materials. However, in practical ultrafast dynamic measurements, the dynamic curves are usually affected by the pump power density. A proper pump power density should be employed to gain intrinsic decay dynamics.

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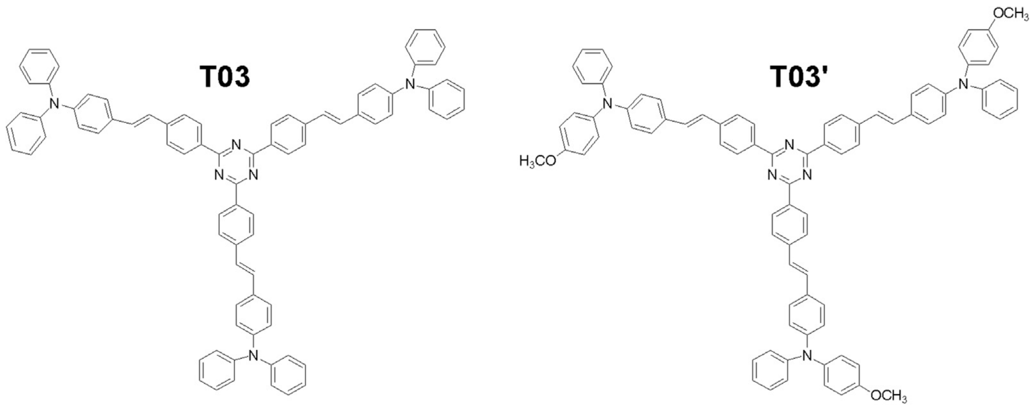

Fig 1. Molecular structures of compounds T03 and T03'.

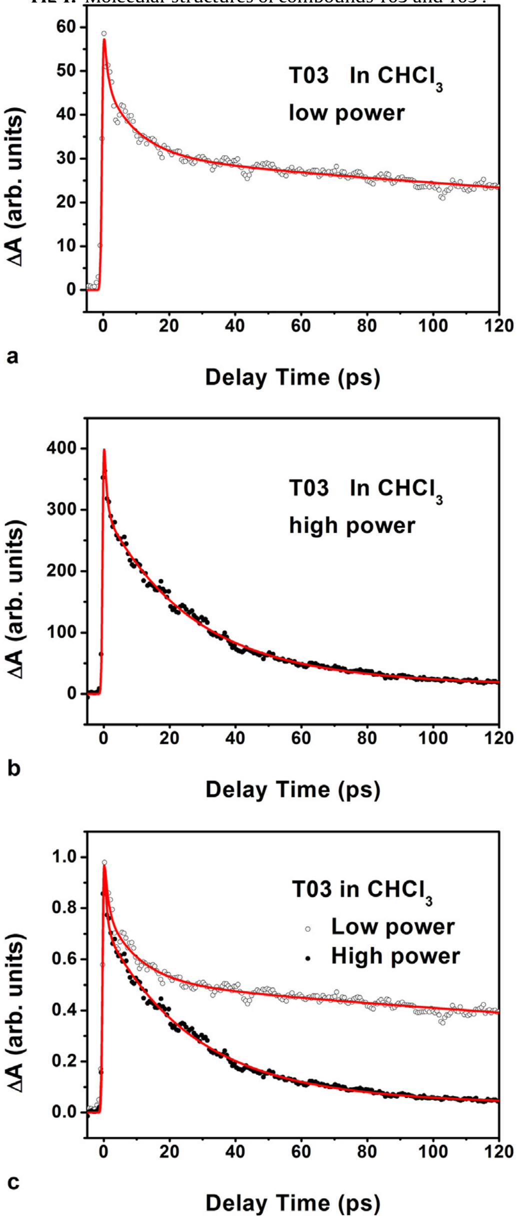

Fig. 2. Degenerated pump-probe dynamics for compounds T03 dissolved in $CHCl_3$ solutions, under high power density a), under low power density, b). Normalized dynamics curves measured under excitation of high and low power densities. (With a 400 nm pump and probe).