

Fluorescence Dynamics in Heterostructured *trans*-Stilbene

Renata Karpicz¹, Gabrielė Kareivaitė¹, Mindaugas Mačernis², Darius Abramavičius², Leonas Valkūnas^{1,2}

¹Center for Physical Sciences and Technology, Saulėtekio al. 3, Vilnius, Lithuania

²Institute of Chemical Physics, Faculty of Physics, Vilnius University, Saulėtekio al. 3, Vilnius, Lithuania
Renata.karpicz@ftmc.lt

1. Introduction

A variety of organic molecules, especially diarylethylenes, due to their sensing abilities, is considered promising components of highly sensitive instruments for various applications. A range of this type of molecules demonstrates specific photochemical properties, such as, for instance, *trans-cis* isomerization or variability of the fluorescence lifetime depending on environmental conditions. Stilbene is a classic example of such a type of molecules [1]. For example, stilbene monocrystals have been used in scintillating devices, demonstrating the ability to distinguish between effects caused by different illuminations [2].

2. Result and Discussion

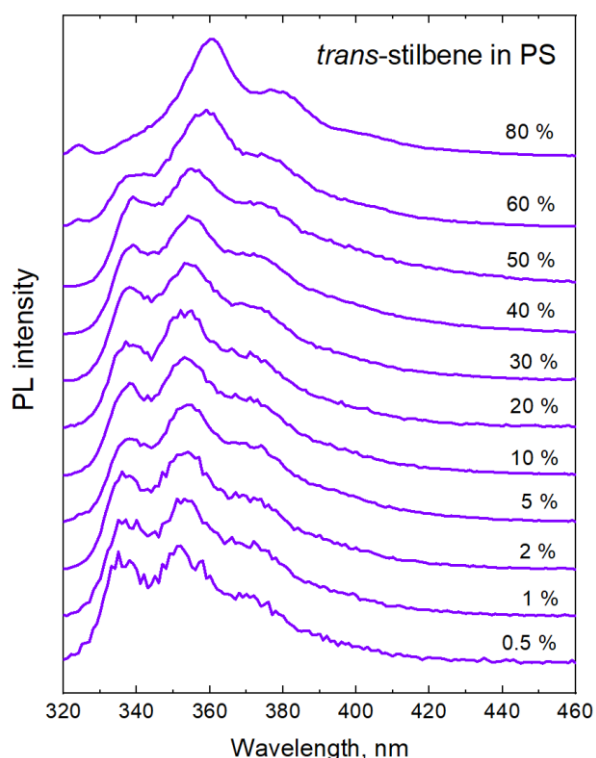


Fig. 1. Photoluminescence spectra of the films with different concentrations of *trans*-stilbene in PS matrix.

In this presentation, studies of the excitation dynamics in polystyrene (PS) films of stilbene are considered in a wide concentration of *trans*-stilbene range, from 0.5% up to 80% wt. The fluorescence spectra and their kinetics are analyzed together with the time-resolved fluorescence measurements performed for the stilbene solutions in chloroform and stilbene in PS matrix. Although there is no isomerization of *trans*-stilbene in PS matrix, by varying concentration, only the aggregates may cause the changes of spectroscopic properties. The increase of *trans*-stilbene concentration resulted in redshift broadening of fluorescence spectral bands (Fig.1). At low concentrations, spectral bands are narrow due to the excitation of separated molecules. The increase in concentration results in the creation of dimers and leads to shorter relaxation times. Contrary to the results obtained in solution and PS matrix, where the excitation dynamics is controlled by molecular twisting process, the fast exciton diffusion yields thermalized exciton distribution and a small number of fluorescence centers responsible for fluorescence line shape and timescale and their temperature dependencies of the bulk solids. The conclusions are also supported by purposeful fluorescence studies at different concentrations of stilbene molecules.

3. Conclusions

Comparing the time-resolved fluorescence of stilbene in solution, PS matrix, and bulk solids, we found that fluorescence decay in solution and PS matrix is controlled by molecular rotation at low stilbene concentrations and nanocluster formation with subsequent aggregation processes at higher stilbene concentrations. The relevant theoretical description explaining these experimental observations based on quantum chemical calculations is analyzed for the stilbene aggregates.

4. Acknowledgement

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5. References

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