CHARACTERIZATION OF TRANS-STILBENE NANOCRYSTALS IN POLYSTERENE FILMS BY CARS AND AFM MICROSCOPY AND OPTICAL SPECTROSCOPY

Ivan Halimski[1], Renata Karpicz[1], Andrej Dementjev[1], Marija Jankunec[2], Jevgenij Chmeliov[1,3], Mindaugas Macernis[3], Darius Abramavicius[3], Leonas Valkunas[1,3]

[1]Department of Molecular Compound Physics, Center for Physical Sciences and Technology, Lithuania
[2]Institute of Biochemistry, Life Sciences Center, Vilnius University, Lithuania
[3]Institute of Chemical Physics, Faculty of Physics, Vilnius University, Lithuania
ivan.halimski@ftmc.lt

The most well-known feature of stilbene molecules is *trans-cis* isomerization, which makes them perspective for molecular switches [1]. Moreover, isomers themselves found their own applications. For example, *trans*-stilbene (Tstilbene) could be used as neutron detector for radiation detection [2]. The knowledge about properties of Tstilbene in different conditions (temperature, concentration, etc.) is critically important for applications and, probably, to expand the scope of application.

In the previous studies, unusual Tstilbene fluorescence dependence on temperature [3], as well as aggregation-related spectroscopic optical properties dependent on concentration, were investigated [4]. The thickness of the stilbene-containing film is another important parameter that could affect the sample's properties. Combination of steady-state and time-resolved optical spectroscopy with Coherent Anti-Stokes Raman Scattering (CARS) and Atomic Force Microscopy (AFM) provides an opportunity to understand, how changes in structure (aggregation, dimerization) affect spectroscopic behavior.

In this work, we investigate Tstilbene aggregation and crystallization in polystyrene (PS) matrix in thin films. The effect of both film thickness (by varying PS concentration in chloroform) and Tstilbene concentration (by varying Tstilbene mass-ratio in PS matrix) are studied.

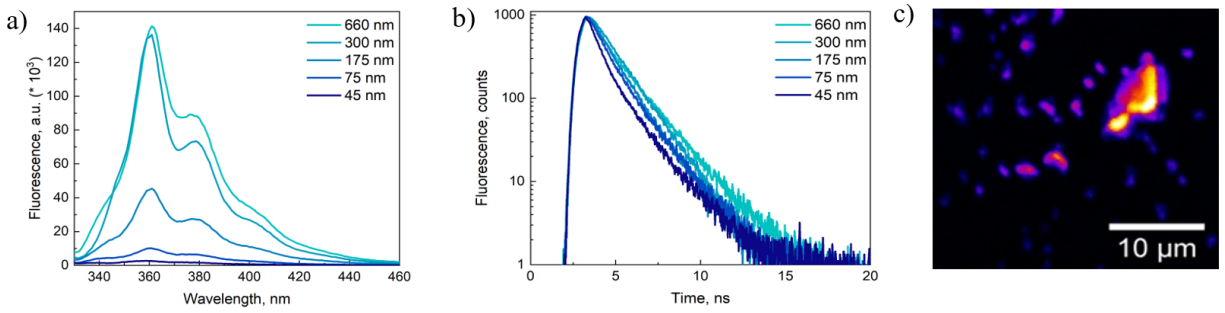

Fig. 1. Fluorescence spectra of 80% Tstilbene dependent on film thickness b) Corresponding time-resolved fluorescence spectra (kinetics) at λ_{em} = 360 nm. c) CARS image of 80% Tstilbene 175 nm PS film (scan 30μm × 30μm).

Such data analysis techniques, as kinetics fitting with sample-decay and stretched-exponential [5,6] decay models, spectra and kinetics decomposition, combined with microscopy analysis provide information about formation of aggregates of different sizes, their influence on optical properties. Moreover, here we show dependence on properties (concentration and thickness) being changed simultaneously. That means, it is possible to *control* structure via changing parameters.

[1] V. Nagarajan et al., Condens. Matter Phys. 21, 43010 – 43012, 2018.
[2] L. Carman et.al, Journal of Crystal Growth. 368, 56 – 61, 2013.
[3] R. Karpicz, et al., Phys. Chem. Chem. Phys. 23, 3447 – 3454, 2021.
[4] R. Karpicz, et al., Phys. Chem. Chem. Phys. 25, 21183 – 21190, 2023.
[5] J.R. Lakowicz, Principles of fluorescence spectroscopy, 2010.
[6] J. Tamosiunaite, et.al., Chemical Physics. 572, 111949 – 111960, 2023.