Effect of Dispersion in Various Liquid Crystal Matrices on the Excitonic Properties of Cyanine Dye J-Aggregates

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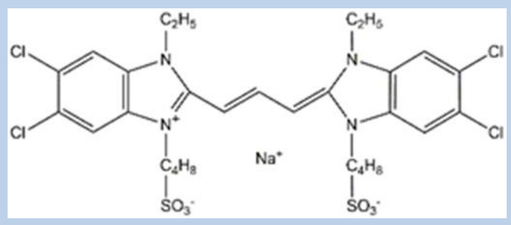
a



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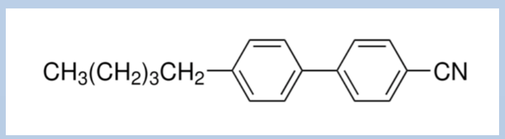
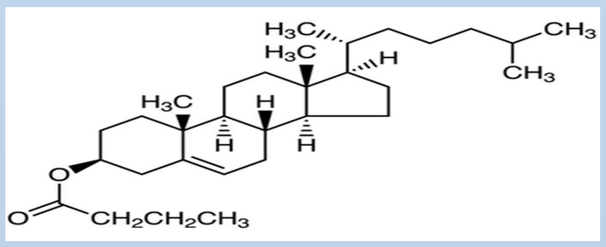


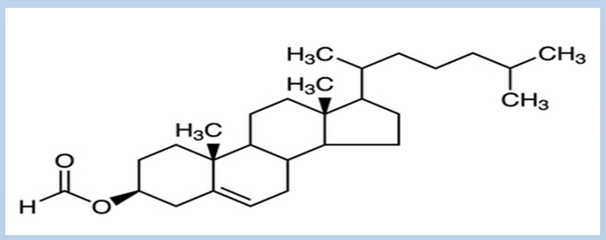
Structural formula of TDBC (a) and 5CB (4-Pentyl-4-cyanobiphenyl) (b)

In recent years, liquid crystals (LCs) have gained increasing attention as host matrices for incorporating and dispersing various inorganic and organic nanoparticles. This trend is evident in both fundamental research and the development of novel composite nanomaterials. A particularly intriguing aspect of these studies involves organic substances that, while exhibiting poor solubility in LC matrices, cannot be treated as conventional non-mesogenic dopants. However, with specific techniques, these substances can be successfully introduced into the orientationally ordered LC structure, influencing both phase transitions and various physical properties. In this context, J-aggregates – spontaneously formed organic nanoparticles – have attracted significant interest for their potential interactions with liquid crystals as anisotropic, ordered fluids.

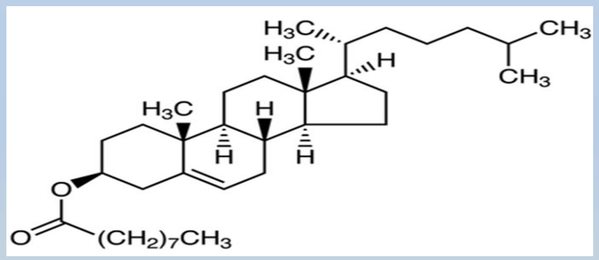
Recently, we reported the formation of J-aggregates of the anionic cyanine dye TDBC in a nematic LC matrix 5CB along with an analysis of the optical-fluorescent and electro-optical properties of the resulting novel material [1].



cholesteryl pelargonate



cholesteryl formate



cholesteryl butyrate

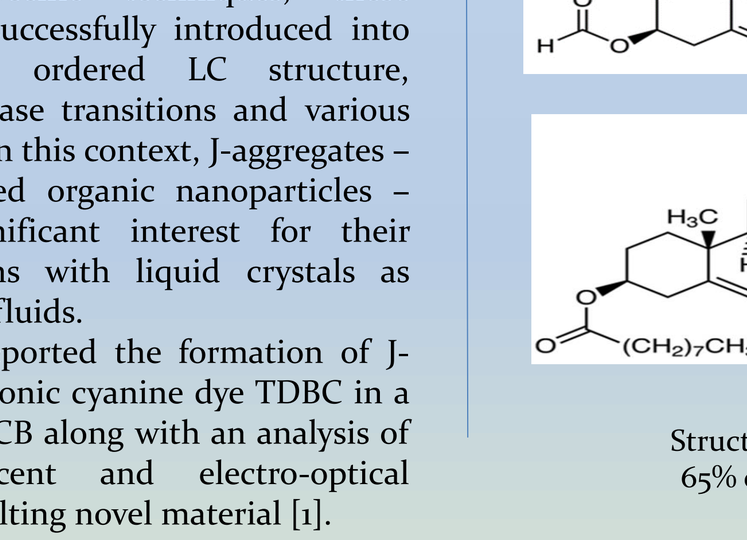
Structural formula M5 (a mixture of cholesterol esters: 65% cholesteryl pelargonate, 30% cholesteryl formate and 5% cholesteryl butyrate)

Results:

a

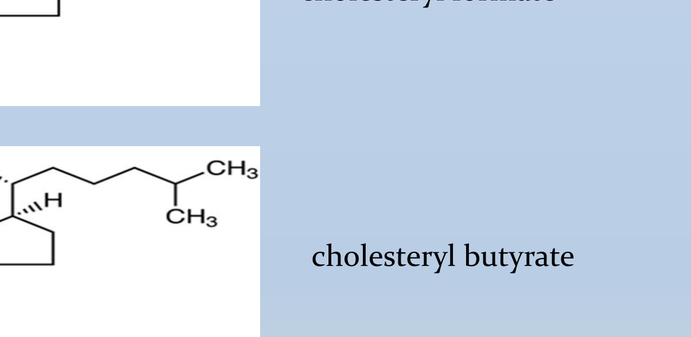
Absorption spectra of TDBC J-aggregates formed in M5(a) and 5CB(b)

a

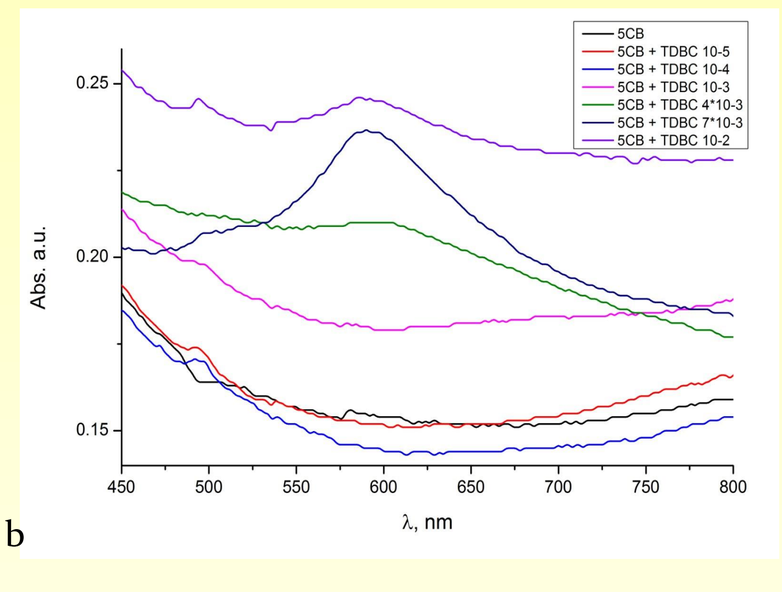


Luminescence (λ_{exc} = 530 nm) spectra of TDBC J-aggregates formed in M5(a) and 5CB(b)

a

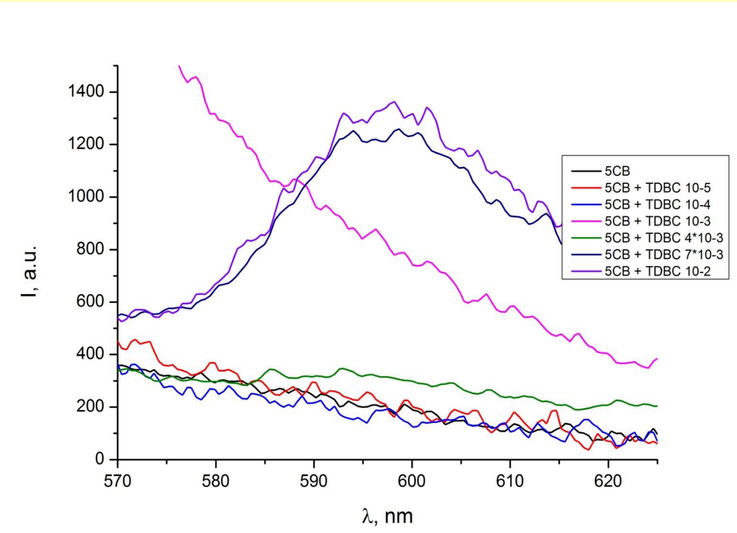


b



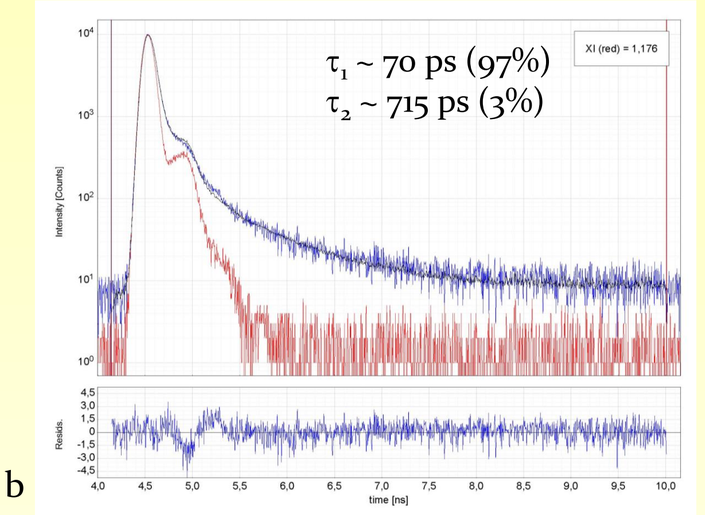
Absorption spectra of TDBC J-aggregates formed in M5(a) and 5CB(b)

b



Luminescence (λ_{exc} = 530 nm) spectra of TDBC J-aggregates formed in M5(a) and 5CB(b)

b



Luminescence decay curves (λ_{reg} = 600 nm) of TDBC J-aggregates at $C_{TDBC} = 10^{-2}$ M formed in M5(a) and 5CB(b)

Conclusions:

These findings underscore the potential of J-aggregates in LC matrices for the development of novel luminescent liquid crystal materials. Our results provide insights for further detailed investigations into these promising nanostructured materials, offering avenues for future research and technological advancements.

References:

1. I.I. Grankina, O.M. Samoilov, N.A. Kasian, I.Yu. Ropakova, S.S. Hrankina, S.L. Yefimova, L.N. Lisetski, O.V. Sorokin, Opt. Mat. Express 13 (6), 1741 (2023). http://dx.doi.org/10.1364/OME.491678