From Liquid Crystal Dimers to Supramolecular Assemblies in Water with a Touch of Chirality

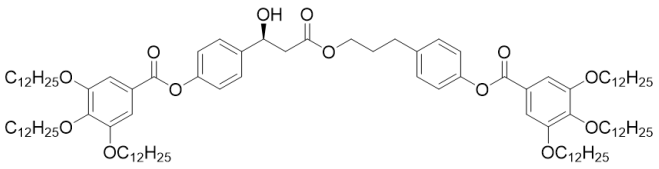
Anamarija Knežević

Laboratory for stereoselective synthesis and biocatalysis, Division of Organic Chemistry and Biochemistry, Ruđer Bošković Institute, Bijenička cesta 54, 10000 Zagreb, Croatia
email: anamarija.knezevic@irb.hr

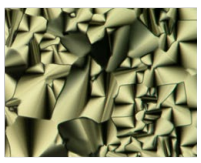
Over the past few decades, there has been a focus on self-assembly and supramolecular chemistry for the development of new organic materials, such as monolayers, nanostructures, gels, membranes, and liquid crystals [1]. The properties of these functional supramolecular materials depend both on the molecular structure of the building blocks and the conditions under which the materials are assembled [2].

The self-assembly process of mesogenic molecules is driven by the same intermolecular interactions regardless of whether it occurs in solution or in bulk. However, studies that compare these closely related systems are scarce [3]. The self-assembly of mesogenic molecules in bulk, which is temperature-dependent, results in formation of liquid crystal (LC) phases with a wide range of properties. In a similar vein, molecular building blocks in liquid media generate nanomaterials with diverse features interesting for technological and biomedical applications, particularly when the liquid is water.

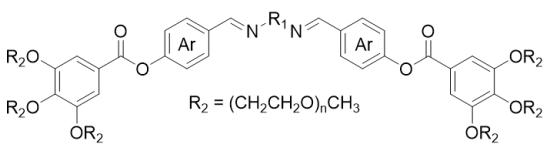
Herein, the structure-property relationship of LC flexible dimers will be discussed, with an emphasis on chiral LCs [4], a distinct class of LCs with unique optical and mechanical properties. Here, the chiral 3-aryl-3-hydroxypropanoic ester moiety has demonstrated its versatility as a building block for the preparation of chiral LC compounds. Furthermore, the transformation of LC molecules into amphiphilic molecules, shaped by the design of LC dimers, will be elucidated. The replacement of alkyl chains in the structure of LC dimers with oligo(ethylene glycol) chains provides water-soluble molecules that self-assemble into supramolecular structures forming hydrophobic pockets. The development of these water-soluble molecules holds significant potential in the creation of novel materials.



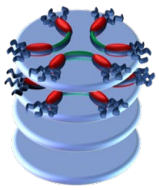
LC dimer



Columnar LC phase



Amphiphilic dimer



Nanotubes in water

References

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[2] D. B. Amabilino, D. K. Smith, J. W. Steed, *Chem. Soc. Rev.* **2017**, *46*, 2404–2420.
[3] M. Castillo-Vallés, A. Martínez-Bueno, R. Giménez, T. Sierra, M. B. Ros, *J. Mater. Chem. C* **2019**, *7*, 14454–14470.
[4] I. Dokli, A. Ožegović, A. Šimanović, M. Hromin, A. Knežević, A. Višnjevac, A. Lesac, *J. Org. Chem.* **2022**, *87*, 14045–14057.