Fullerene-Filled Star Mesogens – On the Way to Liquid Crystal Photovoltaics?

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In the last decade hybrid materials from donor chromophores and Fullerenes as acceptors have been attracted great interest for the application in photovoltaic devices.[1,2] However, even the best materials reveal only low efficiencies owing to structural defects, low quality of alignment, moderate relative permittivity, fast recombination and the macroscopic separation of the components among others. Liquid-crystalline covalent bound dyads may introduce important advantages over other materials, because they can in principle be well aligned and reveal often rather highly ordered and well nanosegregated structures.[2,3]

Recently, our group focused the research on star-shaped, shape-persistent mesogens **1** and **2** with 1,3,5-benzene or Phthalocyanine cores and conjugated oligomers as arms decorated with aliphatic or oligo(ethyleneoxy) chains (R).[4,5] The intrinsic void can be filled with Fullerenes, which were attached to one or more arms using spacers of various lengths (n). The stacking of these mesogens has been studied by comprehensive X-ray scattering methods and simulation.

This contribution will highlight the beautiful hierarchical self-assembly in double-nanosegregated helical columns, which can be fine-tuned by the spacer length for molecules **1c**. Even mixtures of Fullerene containing non-LC compounds (**1b**, **2b**) with the parent stars without Fullerene (**1a, 2a**) self-organize in such donor-acceptor stacks. For the Phthalocyanine derivatives **2** a limited range of mixtures of components **2a** and **2b** can be aligned and result in π-stacked columns, in which the Fullerenes are nanosegregated at the periphery of the columnar stacks. Only derivatives **2** can be decorated with oligo(ethyleneoxy) chains without loss of mesomorphic properties. The optimization of these mesogens for the development as possible new LC photovoltaic materials will be discussed.

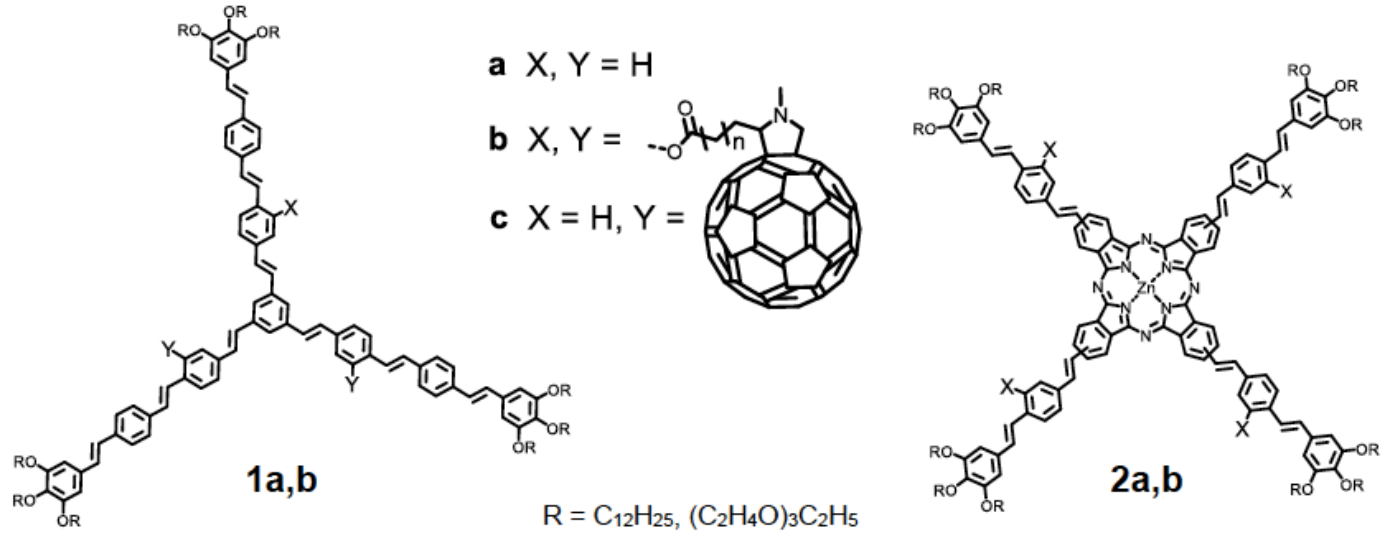

Figure: Donor-acceptor dyads under investigation.

References

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