Dynamism in self-assembling discotic molecules: From flexible electronics to anticounterfeiting

Berta Gómez-Lor[1]

[1] *Materials Science Institute of Madrid (ICMM-CSIC), E-28760 Madrid*

The liquid crystal is an intermediate phase of matter whose properties lie between those of conventional liquids and those of solid crystals.[1] The so-called liquid crystalline *mesophases* are fluid like liquids, but, in these mesophases, molecules are oriented like in crystals. The combination of fluidity but order, and thus the ability to respond to light or electric fields, is behind their widespread use in electro-optical displays (LCDs), which have revolutionized the information display industry in the 20th century.

In recent years, interest in liquid crystals has gone far beyond the display application, by exploiting not only their stimuli-responsive characteristics, but also as a tool to achieve favorable self-assembly and self-healing properties. In fact, the liquid crystalline state can be induced in shape-anisotropic molecules with flexible peripheral chains, by the action of temperature or solvents.

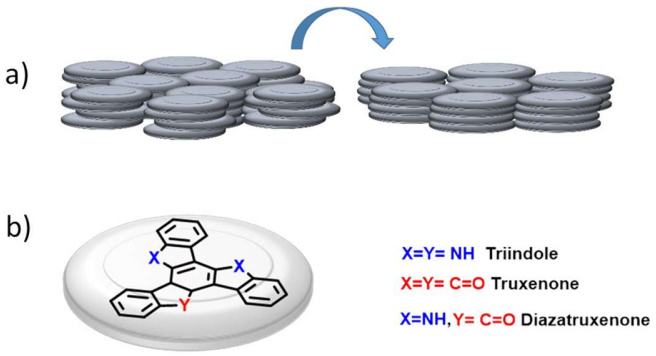

Fig. 1: *Chemical structure of discotic scaffolds: triindole, truxenone and diazatruxenone*..

Of particular interest are discotic liquid crystals usually composed by a rigid inner aromatic disk-like core surrounded by a number of flexible chains linked to it.[2] In the discotic mesophases molecules are stacked on top of each other forming highly ordered columnar superstructures along which the orbital overlap between adjacent molecules favors the one-dimensional migration of charge carriers, making them ideal organic semiconductors with applications in photovoltaics, light-emitting diodes, field-effect transistors, lasers…

We have been long involved in the development of high mobility *n*-, *p*-type or ambipolar semiconductors, based on truxenone,[3] triindole,[4] and diazatruxenone[5] (see Figure 1). In this talk we will show how, by controlling the dynamism of these liquid crystals at the molecular scale, we can optimize their properties and achieve the necessary balance between efficient charge transport and processability for their incorporation into electronic devices or confer them interesting stimuli-responsive behavior of interest in anticounterfeiting applications and smart devices.

References:

[1] H. K. Bisoyi and Q. Li, *Chem. Rev.* **122**, 4887 (2022).
[2] T. Wöhrle, I. Wurzbach, J. Kirres, A. Kostidou, N. Kapernaum, J. Litterscheidt, J. C. Haenle, P. Staffeld, A. Baro, F. Giesselmann and S. Laschat, *Chem. Rev.* **116**, 1139 (2016).
[3] S. Gómez-Esteban, A. Benito-Hernandez, R. Termine, G. Hennrich, J. T. L. Navarrete, M. C. Ruiz Delgado, A. Golemme and B. Gómez-Lor, *Chem.Eur. J.* **24**, 3576 (2018).
[4] C. Ruiz, I. Arrechea-Marcos, A. Benito-Hernández, E. Gutierrez-Puebla, M. A. Monge, J. T. López Navarrete, M. C. Ruiz Delgado, R. P. Ortiz and B. Gómez-Lor, *J. Mater. Chem. C* **6**, 50 (2017).
[5] A. Benito-Hernández, M. T. El-Sayed, J. T. López Navarrete, M. C. Ruiz Delgado and B. Gómez-Lor, *Org. Chem. Front.* **5**, 1748 (2018).