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New polyfluorinated liquid crystals

Nowadays liquid crystals are compounds of great interest due to their applications mainly in the fields of electronics and optics (displays). Molecules that form them must show thermal, chemical and photochemical stability. Moreover, these compounds must exhibit liquid crystal behaviour for a wide range of temperatures. In this work, we have prepared new molecules containing a large number of fluorine atoms in their structures, which show these characteristics.

References

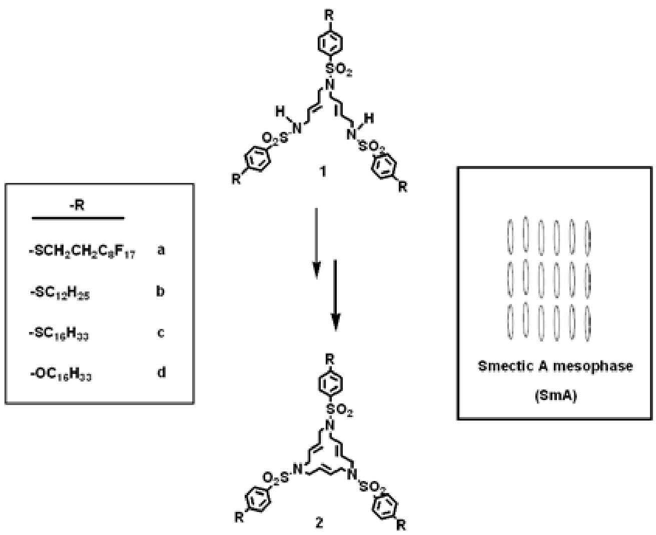
R. Soler, E. Badetti, M. Moreno-Mañas, A. Vallribera, R.M. Sebastián, F. Vera, J.L. Serrano, T. Sierra Liquid Crystals, 2007, 34, 235-240.

Liquid crystal behaviour appears under certain conditions, when phases of compounds show molecular order that is intermediate between that of an ordered solid crystal and a disordered liquid or solution. These intermediate phases are called mesophases, and the compounds that lead to them are mesogens. These materials combine properties of both the crystalline state (optical and electrical anisotropy) and the liquid state (molecular mobility and fluidity). There are two different ways in which a mesophase can be formed, and these give rise to the main classes of liquid crystals. If mesophases are generated by the action of temperature, the liquid crystal is termed thermotropic (these are the most common and the ones obtained in this study); if they are generated by the presence of a solvent, they are known as lyotropic. It is very difficult to foresee which molecules could be active in this field; the only similarity among all the mesogen compounds is the presence of long carbon atom chains in their structures.

A good synthetic pathway for the preparation of molecules of Scheme 1 has been well established by our group. They are opened or cyclic compounds containing long carbon atom chains, which can be completed with hydrogen atoms (hydrocarbon chains) or by fluorine atoms (polyfluorinated chains).

From the results obtained from the studies of these new compounds, we can conclude: a) products with hydrocarbon chains linked to the ring by a sulphur atom (S) do not show liquid crystal behaviour (**1-2b,c**), however compounds containing polyfluorinated chains are active (**1-2a**); b) our new polyfluorinated compounds exhibit, in a range of temperatures, Smectic A mesophases, where molecules are aligned into layers, ones parallel to the others (Scheme 1, Figure 1); c) the nature of the heteroatom that link the chains to the ring is important (**2c** is not mesogen but **2d** it is); d) mesophases of polyfluorinated compounds appeared at higher temperatures over wider ranges (49.3-57.8 ºC for **2d** and 183.2-216.6 ºC for **2a**); e) the length and the position of the chains on the aromatic ring are also important.

The presence of a high number of fluorine atoms in the molecules enhances their stability and the probability of obtaining liquid crystals over wide temperature ranges.



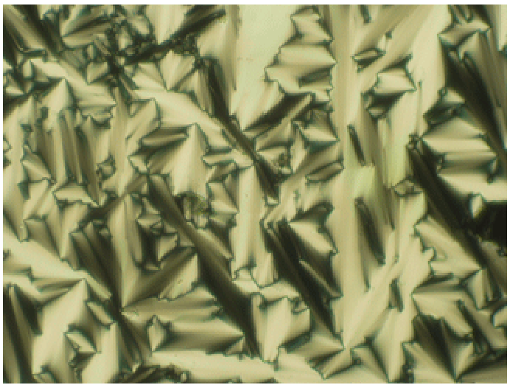


Figure 1. Polarized optical micrograph of one of our Smectic A mesophases (200 ºC). The order of the molecules promotes characteristic textures.

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