Synthesis of New U-Shaped Azobenzene Liquid Crystals for Photoswitching Properties

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ABSTRACT

A new series of liquid crystalline compounds comprising a U-shaped unit as central core incorporating azobenzene in the side arms and having terminal alkene functional groups, is synthesized and characterized by differential scanning calorimetry (DSC), polarized-light optical microscopy (POM), X-ray diffraction analysis and UV-vis spectroscopy. In the U-shaped series, all compounds showed stable enantiotropic monolayer SmA phases independent on the chain length and chain parity. These U-shaped molecules exhibit strong photoisomerisation behaviour in solutions and in solid state. The photoswitching properties of compounds showed*trans* to *cis* isomerization in about 15 seconds, whereas reverse process required much longer times ranging from 235–380 min in solutions. In case of solid film of **4a**, *E*–*Z* photoisomerization takes around 4 s and the reverse transformation to original *Z*–*E* state takes about 74 min. The kinetic study using UV light irradiation shows that all compounds (**4a–e**) behave first order rate law throughout the relaxation time in solution. The effect of alkyl chain length for *trans* to *cis* is negligible whereas, *cis* to *trans* is substantial on the odd–even chain length. The photoisomerization study with variable light intensities shows that the photosaturation and thermal back relaxation times are decreased when intensity of the irradiated light is increased. Compounds did not degrade with light illumination at 10 mW cm^{-2}. The reversible isomerization did not significantly decay after multiple cycles indicating that the photo-responsive properties are stable and repeatable. Thus, the photoswitching behaviour of these materials may be suitably exploited in the field of optical data storage device and in molecular switches for suitable switching times.

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