Wrocław University of Technology

Centre for Advanced Materials and Nanotechnology

Institute of Physical and Theoretical Chemistry

Organic Materials for Photonics

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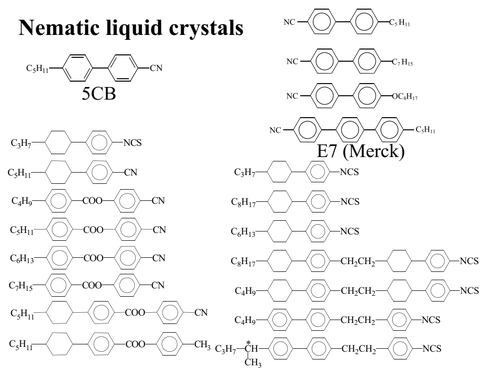
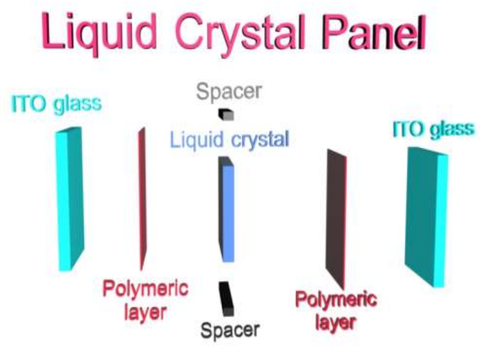
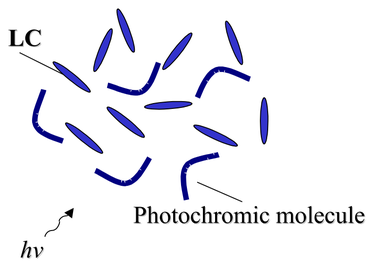
PHOTOREFRACTIVE LIQUID CRYSTALS



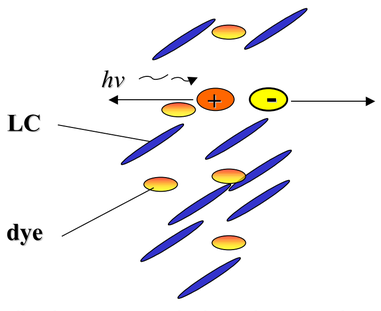
We report four types of mechanisms occurring in photorefractive liquid crystal panels based on hybrid construction. The photorefractive liquid crystals are widely studied due to their potential use in many optical devices employing the strength of holographic techniques. There is no single material, which can be equally used for all photonic applications. However, all photorefractive functions can be fully exploited in liquid crystal cells by a proper cell construction as well as a proper choice of materials and by tailoring their properties. The key significance in those systems posses the liquid crystal molecules. An unique property of low-molar mass liquid crystals is their ability for changing the effective index of refraction as a result of an action of electric field or interaction with photochromic molecules. Designed by us



Basic ideas explaining various models of light induced refractive



reorientation by photochemical photocyclization



bulk photocurrent induced molecular

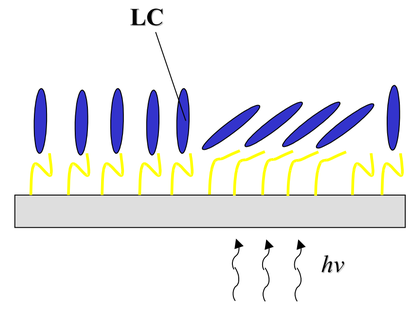
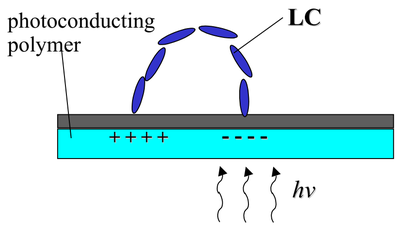
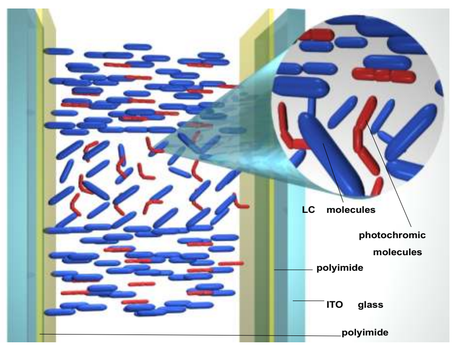


photo-induced command surface of nematics

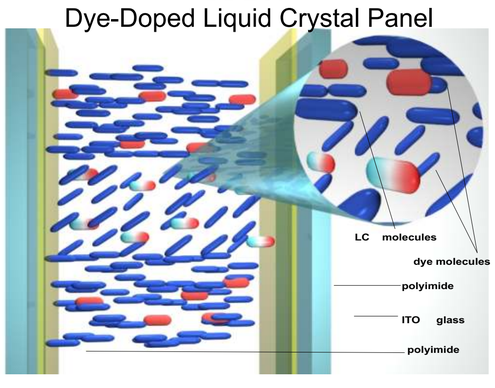


photoinduced space charge in thin film

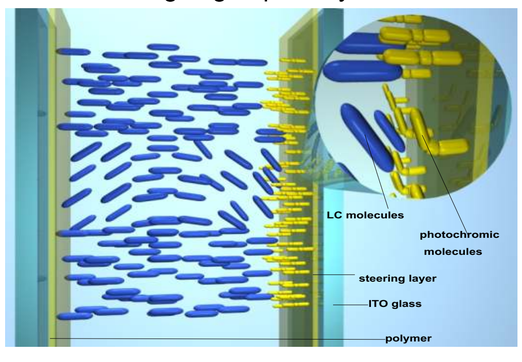
PMLCP
Photochromic Molecules Liquid Crystal



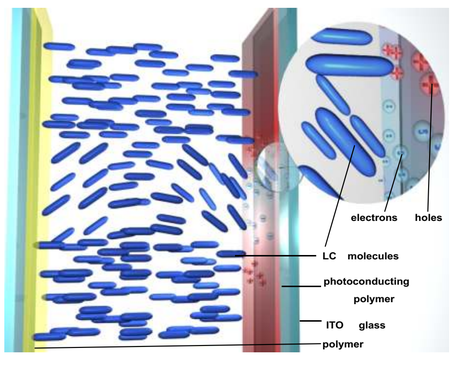
DDLCP
Dye-Doped Liquid Crystal Panel

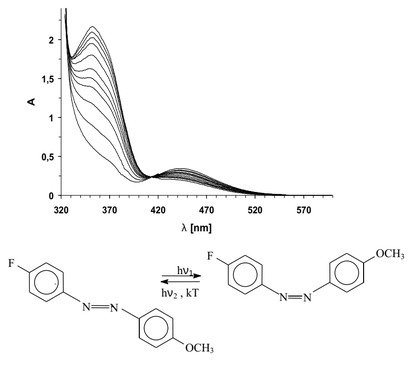


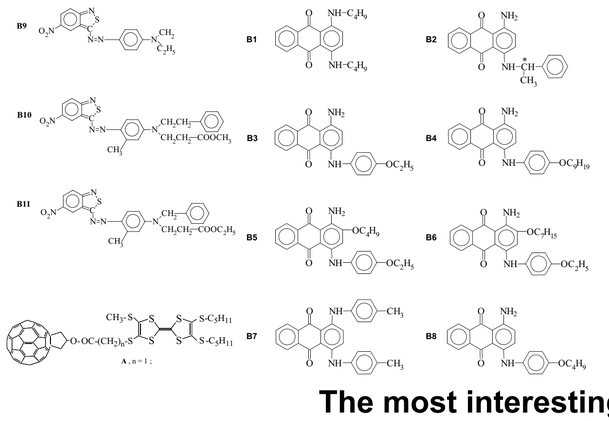
PALCP
Photo-Aligning Liquid Crystal Panel

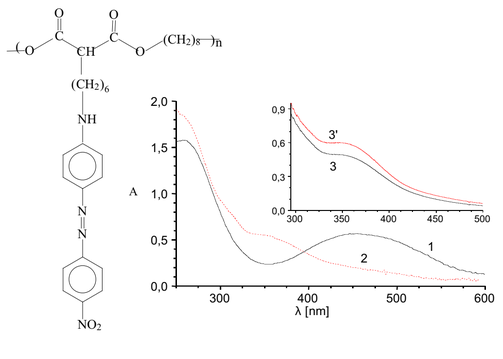


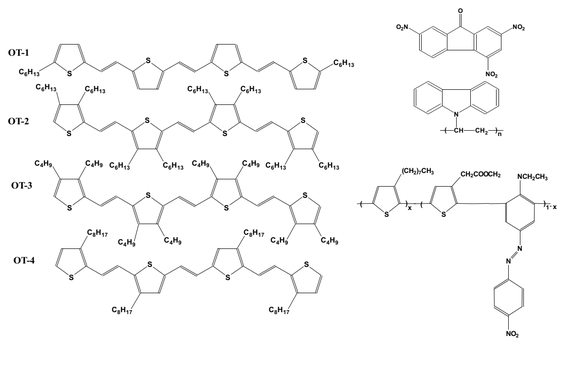
HPLCP
Hybrid Photoconducting polymer









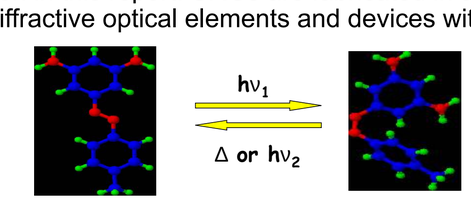


The most interesting properties of LCP:

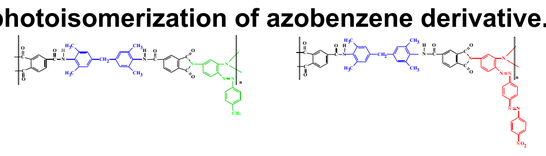
- optical addressing at low light intensities (~ 100 mW/cm^2) - large active area (>2 cm^2), - thickness of LC layer (~ 2- 50 m) - low current, dc voltage steered operation (0 - 20 V) - fast recording and light erasing time ($_R$ ~ 1 - 100 ms) - polarisation sensitive grating recording and reading - phase type (n) holograms can be read by the same or other wavelengths (Raman-Nath diffraction regime)

PHOTOCHROMIC POLYMERS

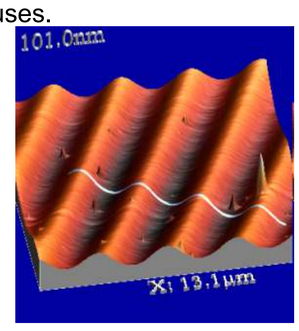
The amorphous azobenzene-containing polymers have been widely investigated in the last decade because of their potential use in various optical applications. Key to many of these applications are light induced optical anisotropies such as dichorism and birefringence. We investigate the mechanisms responsible of these light-induced anisotropies in azobenzene functionalized polymers using holographic techniques. In such case of materials the photoinduced anisotropy is a consequence of efficient reversible *trans-cis-trans* photoizomerization cycles of azobenzene groups. The photoizomerization cycles can also lead to the mass transport in polymers with azobenzene groups covalently attached to the polymer main chain resulting in formation of surface relief gratings (SRGs). We focus our attention on this unusual effect suggesting possible application of this phenomenon in this report. SRGs are fabricated in an all-optical process, without any pre- and/or post-processing procedure. This single step photofabrication of surface relief gratings opens new possibilities for the production of diffractive optical elements and devices with complex surface profiles for photonic uses.



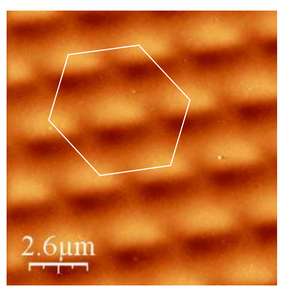
The schemtic view of the reversible *trans-cis-trans* photoisomerization of azobenzene derivative.

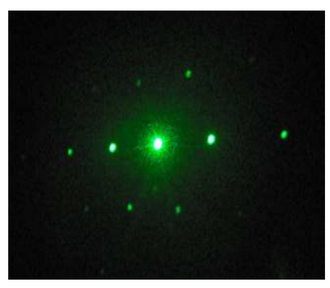


Exemplary chemical structures of azobenzene functionalised



Surface relief grating and its surface profile recorded in azobenzene functionalised polymer. The grating period λ=3 μm.





Hexagonal structure obtained by inscribing there gratings in the same place of the polymer film and the photo of single beam

The diffraction efficiency and speed of hologram formation for all presented photorefractive materials can easily find application in many practical devices like: optical memories, novelty filters, multiplexers, optical processors or correlators.

References:

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