Chapter

Polymer Dispersed Liquid Crystals

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Citations (4) References (80)

Abstract

Low molar mass liquid crystals (LCs) are typically not soluble in polymer systems to any great degree. When the two different materials are mixed, this leads to two-phase systems whose morphology depends on a variety of factors including, primarily, the concentration. The resulting two-phase structures can have inclusions with nanometer through macroscopic dimensions. Although there are a large number of variants, these structures are generically called 'polymer dispersed liquid crystals' (PDLCs) when the resulting morphologies lead to systems that scatter light. This is often achieved in the intermediate concentration region (30–70% LC), in which morphologies with large mesoscale inclusions are typically formed. If the refractive index matching is done correctly, upon application of an electric field, the scattering can be turned off by an electric field, leading to dynamic transparency. This is a review of past literature with a focus on the type of morphologies that can be exhibited. Basic electro-optic properties are discussed as is the large variety of morphologies that can be induced. Also included is the related research area of 'periodic' PDLC systems, wherein the phase separation process is induced spatially. This leads to anisotropic systems where an electric field can control diffraction, instead of scattering.

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... The PDLCs doped with nanoparticles and nanotubes have been explored to enhance electro-optical properties, and the low concentration (< 3% by weight) is usually chosen to yield a more stable and even distribution in the LCs [15][16][17]. Because nanoparticles are potential to affect the morphologies and properties of the PDLCs in multiple ways, usually it is difficult to predict how the doped PDLC will perform relative to the un-doped one [18] . It is known that when the PDLCs doped with nanoparticles, the morphology of PDLCs would change with the concentration and size of the nanoparticles, and such changes can induce the enhancement of dielectric properties and electro-optical effects [19][20][21][22][23][24][25]. ...
... For the positive LC, i.e. n o < n e , from Eq. (18) , n eff decreases with the voltage increasing. Since the average refractive index <n> is higher than n p , the difference between <n> and n p results in the scattering, so that the film is opaque on the off-state. ...

Polymer dispersed liquid crystals doped with low concentration γ -Fe 2 O 3 nanoparticles

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Sep 2021 · LIQ CRYST

Xiangshen Meng · Jian li · Yueqiang Lin · Zhenghong He

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... Once an electric field above a certain threshold value is applied, the films become transparent which is attributed to the array of LC molecules along the electric field. Additionally, the electrically switchable property is realised only if the refractive index (RI) of the polymer matrix precisely matches with the ordinary RI of the LC by applying an electric field [7][8] [9] [10]. This electric field-controlled scattering of the PDLC films is the root application that holds significant promise for many optoelectronic devices, such as switchable windows [11], displays [12], diffuser film [13,14], anti-peeping film [15], quantum dots (QDs) film [16], and components of organic light-emitting diode (OLEDs) [17], field effect transistor (FET) [18], energy storage [19] and solar-energy harvesting [20]. ...

Liquid Crystals ISSN: (Print) (Effects of multifunctional acrylates and thiols on the morphology and electro-optical properties of polymer-dispersed liquid crystal films Effects ...

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Feb 2021

Mohsin hassan Saeed · Yanzi Gao · Le Zhou · Huai Yang

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... Polymer dispersed liquid crystals (PDLCs) are electrically switchable thin films containing phase-separated liquid crystal (LC) droplets embedded in a continuous polymer matrix [1][2] [3] . Without applied electric field, these films exhibit a milky white scattering state due to random orientation of liquid crystal (LC) droplets in the polymer matrix. Once the electric field is applied, the films become transparent and this phenomenon is attributed to the alignment of LC droplets along the direction of electric field, provided that the ordinary refractive index n o of LC precisely matches with the refractive index n p of polymer matrix [4][5][6][7]. ...

Effects of oxygen heterocyclic acrylate monomers on the morphologies and electro-optical properties of polymer dispersed liquid crystal composite films

Article

Mar 2021 · OPTIK

Mohsin hassan Saeed · Shuaifeng Zhang · Meina Yu · Huai Yang

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... Without the applied electric field, PDLC films exhibit a milky white scattering state

due to the random orientation of liquid crystal (LC) droplets in the polymer matrix [4,5]. Once the electric field of sufficient strength is applied, these films become transparent and this phenomenon is attributed to the alignment of LC droplets along the direction of electric field, provided that the ordinary refractive index n o of LC precisely matches with the refractive index n p of polymer matrix [6][7] [8] . Recently, PDLC films have gained significant attraction in the context of their promising applications in the electro-optical devices such as optical diffusers, biosensors, energy-saving smart windows, optical shutters, anti-peeping films, and flexible largearea display devices [9] [10][11][12][13]. ...

Effects of rigid structures containing (meth)acrylate monomers and crosslinking agents with different chain length on the morphology and electro-optical properties of polymer-disperse...

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May 2020 · J MOD OPTIC

Mohsin hassan Saeed · Shuaifeng Zhang · Le Zhou · Huai Yang

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Quantitative SEM Characterization of Polymer-Dispersed-Liquid-Crystal Films

January 1990 · Molecular Crystals and Liquid Crystals Incorporating Nonlinear Optics

J. R. Havens · D. B. Leong · K. B. Reimer

Large-area displays and light valves can be made by dispersing nematic liquid-crystal droplets in a polymer matrix. To switch between scattering and transparent states of the polymer film, an electric field is used to alter the refractive index of the droplets by changing the orientation of their liquid- crystal directors. The film morphology—by which we mean the size, shape, and spatial ... [Show full abstract]

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Article

Reflective liquid crystal display materials: liquid crystal-polymer dispersions

January 1995

Gregory P. Crawford

The study of liquid crystal-polymer dispersion materials has burgeoned in recent years because of their potential in flat panel display technologies and richness in physical phenomena. The concentration of polymer can be as large as 70% or as small as 1% depending on the application and type of polymer used. The composite nature of these dispersions affects the ordering of the liquid crystal and ... [Show full abstract]

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Article

Bistable Diffractive Electro-Optical Effect in Cholesteric Gels

March 1997 · Japanese Journal of Applied Physics

H.-S. Kitzerow

The present study shows that a cholesteric gel consisting of a low molar mass liquid crystal and a highly crosslinked anisotropic network can be switched between a transparent and a colored scattering state. The latter state can be induced in an initially non-aligned cholesteric liquid crystal by an electric field, as described recently by Chilaya and coworkers. A short pulse of an electric field ... [Show full abstract]

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Article

Organic doped sol - gel glasses for electro-optics and display applications

January 1999 · Pure and Applied Optics Journal of the European Optical Society Part A

David Levy

Gel-glass dispersed liquid crystal (GDLC) films may be used as electro-optic devices. Films scatter light according to the number of droplets and the relative refractive indices of the LC and the silica matrix. LCs are birefringent; therefore their refractive index depends on the LC orientation and the optical angle of incidence. If the film is coated with transparent electrodes, and an electric ... [Show full abstract]

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Surface Anchoring and Surface Memory in Dispersions of Polymers and Liquid Crystals

March 1998

Karl Amundson · Mohan Srinivasarao

Surface anchoring of liquid crystals at interfaces created by polymerization-induced phase separation was studied. Such surfaces are created during the formation of some polymer-dispersed liquid crystal (PDLC) films. PDLC films have micron-scale drops of liquid crystal dispersed within a polymeric matrix. They can be switched with an electric field from a scattering to a transparent state, and ... [Show full abstract]

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Article

Hidden Gratings in Holographic Liquid Crystal Polymer-Dispersed Liquid Crystal Films

March 2018 · ACS Applied Materials & Interfaces

Luciano De Sio · Timothy J. Bunning · Pamela F. Lloyd · Nelson V. Tabriyan

Dynamic diffraction gratings which are hidden in the field off state are fabricated utilizing a room temperature photocurable liquid crystal monomer and nematic liquid crystal (NLC) using holographic photopolymerization techniques. These holographic liquid crystal polymer dispersed liquid crystals (HLCPDLCs) are hidden due to refractive index matching between the liquid crystal polymer and the ... [Show full abstract]

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A dynamic beam splitter using polymer dispersed liquid crystal materials

October 2012 · Proceedings of SPIE - The International Society for Optical Engineering

Marina Riquelme · Manuel Ortuño · Andrés Márquez · [...] · Augusto Beléndez

We build a dynamic beam splitter with a holographic optical element (HOE). The laser light goes through the HOE and a fraction of intensity diffracted and transmitted could be tuned by an electric signal. We use holographic polymer dispersed liquid crystals materials. It is made by holographic recording in which the liquid crystal molecules diffuse to dark zones in the diffraction grating and ... [Show full abstract]

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