Highly Tunable Magnetic Liquid Crystals

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OTHER INFORMATION

KEYWORDS

Nanorods, magnetic fields, Liquid crystals, Polarization, Waveguide, Anti-counterfeit

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Nanotechnology**
  - Electronics
  - Materials
- **Security and Defense**
  - Other
  - Screening/Imaging
- **Sensors & Instrumentation**
  - Analytical

RELATED CASES

2014-044-0

FULL DESCRIPTION

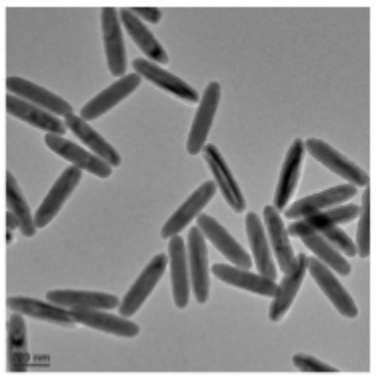
Background

The liquid like behavior and optical anisotropy of liquid crystals have catalyzed many important applications. Their molecular order can be manipulated through external stimuli such as temperature change, electric and magnetic fields - thereby enabling many technological advances – with a particularly successful example being liquid crystal displays driven by electric fields. Conventional liquid crystals (LCs) are mostly sensitive to magnetic fields, therefore development of magnetically actuated liquid crystals opens the door toward various applications which may benefit from the instantaneous and contactless nature of magnetic manipulation.

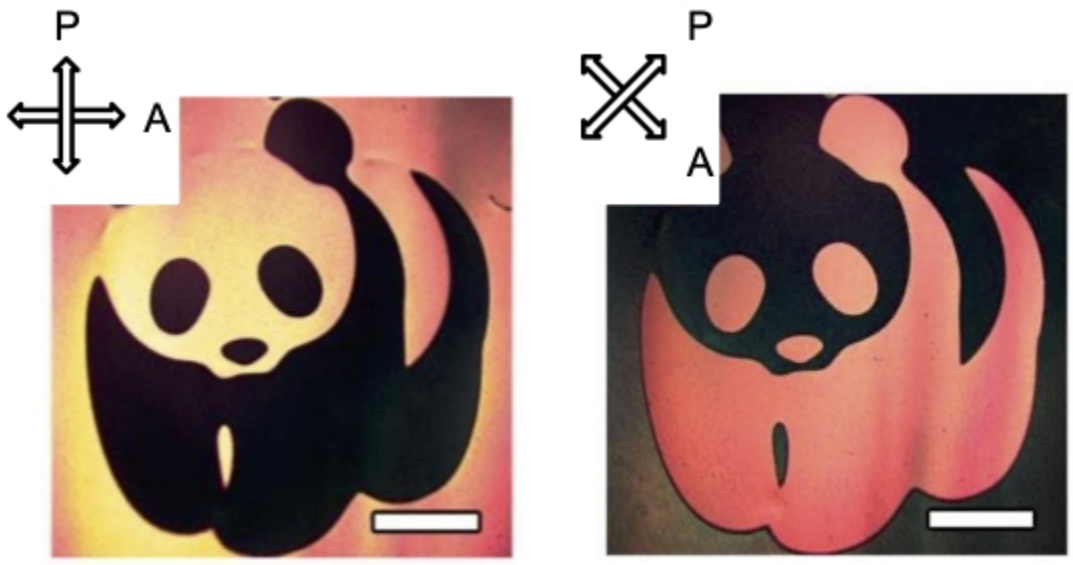
Even with significant advances in colloidal synthesis preparation of magnetic anisotropic nanostructures with a uniform size, well-defined shape and good solution dispersity has remained difficult.

Technology

Prof. Yadong Yin and his research group have successfully produced a magnetically responsive liquid crystal system based on magnetic iron oxide nanorods and demonstrated its instantaneous and reversible orientational tuning using magnetic fields. The nanorods can also be dispersed in a UV curable resin to produce thin film liquid crystals, the orientation of which can be fixed completely or in selected areas by combining magnetic alignment and lithographic processes, allowing the creation of patterns of different polarizations and control over the transmittance of light in particular areas. The developed liquid crystal alters the polarization of light and is able to control the intensity of the light transmitted through it – depending on the direction of the external magnetic field.



TEM image of $Fe_3O_4@SiO_2$ nanorods



Polarized Optical Microscopy images of polarization modulated patterns under cross-polarizer – before and after shifting of transmission axis by 45^{o}.

ADVANTAGES

The advantages of this patented discovery are:

- Fast switching (over 100 Hz) - extremely sensitive and instantaneous response to directional change of external magnetic field.
- The magnetic nanorods can be produced as thin film liquid crystals whose orientation can be fixed in selected areas.
- Electrode less remote control of the optical properties.
- High sensitivity - only weak magnetic force required.

- Provides a new platform for fabricating novel optical devices.

SUGGESTED USES

- Displays
- Waveguides
- Actuators
- Optical modulators
- Anti-counterfeiting features

RELATED MATERIALS

- Magnetically Actuated Liquid Crystals

INVENTOR INFORMATION

- Please visit Prof. Yin's group website to learn more about their research.
- Please review all inventions by Prof. Yin and his team at UCR.
- Please read recent press coverage of Prof. Yin.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,359,678	07/23/2019	2014-044

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