cambridge enterprise
commercialising University science

MULTI-LEVEL PHASE DEVICE

Professor Harry Coles, Dr. Tim Wilkinson and colleagues in the Department of Engineering at the University of Cambridge have developed a device geometry, based on the flexoelectric-optic effect in a chiral nematic liquid crystal, which is capable of linear multi-level phase modulation and frame rates in excess of several kHz. The multi-level phase modulation from these devices has potential for application in holographic projectors, optical correlators and adaptive optics.

This technology offers the advantage over existing devices of having the combination of multi-phase modulation and frame rates in excess of several kHz. By employing flexoelectric devices one can now modulate the phase of light at frame rates well above those detected by the eye, thereby enabling improvement of image quality in holographic projectors as well as the implementation of real-time adaptive ophthalmic imaging for high resolution diagnosis of retinal disease.

For further information please contact:

Dr Robert Fender
✉ Robert.fender@enterprise.cam.ac.uk
☎ +44 (0)1223 760339

Cambridge Enterprise Limited, University of Cambridge
Hauser Forum, 3 Charles Babbage Road, Cambridge CB3 0GTUK
www.enterprise.cam.ac.uk

Case Ref: Wil-2201-08

UNIVERSITY OF CAMBRIDGE

cambridge enterprise
commercialising University science

Background

Traditional liquid crystal on silicon (LCOS) devices can deliver multi-level phase modulation based on planar aligned nematic liquid crystals (LCs) but, due to cell geometry and visco-elastic properties, are only capable of achieving frame rates of around 100Hz (see Figure 1 below).

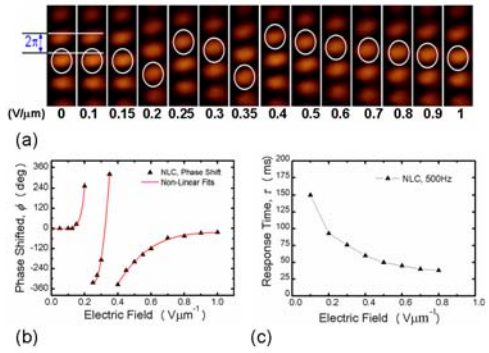

Figure 1: Phase modulation of a nematic LCOS device. (a) Pictures of the far-field interference for different applied voltages. (b) Plot of the phase shift as a function of voltage. The red line represents the Sigmoidal fit of plot. (c) The response times of the phase shift as a function of electric field for different frequencies.

Ferroelectric LCOS devices can deliver frame rates in excess of 10kHz, but are limited to binary phase modulation due to the two stable states that are available through surface stabilisation.

Technology

The researchers in Cambridge have realised that by utilising a chiral nematic LCOS device, and utilising the flexoelectric response of such LC materials, they can achieve a phase shift which is linear in response to an applied electric field.

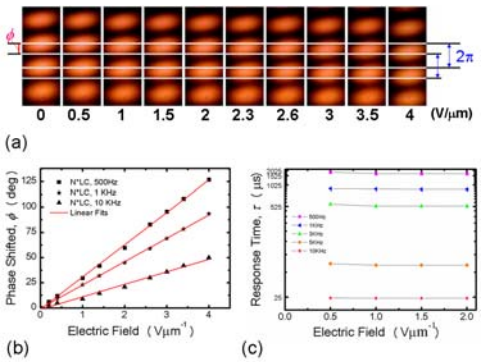

Figure 2: Phase modulation of a flexoelectric-optic LCOS device. (a) Pictures of the far-field interference for different applied voltages. (b) Plot of the phase-shift as a function of voltage. The red line represents a linear fit to the plot. (c) The response times of the phase shift for different frequencies.

Figure 2 illustrates the multi-level phase shift of the present devices. Figure 2(c) shows the response time of the phase modulation as a function of the applied electric field.

The researchers have therefore developed an electric field-induced multi-level phase modulation using the flexoelectric-optic effect in a chiral nematic LCOS device which is capable of frame rates in excess of several KHz.

Commercialisation

We are seeking partners for licensing, collaboration or development of this technology. This technology is described in Optics Express **17**, 7130 (2009) and is protected by International Patent application number PCT/GB2010/000753.

UNIVERSITY OF CAMBRIDGE