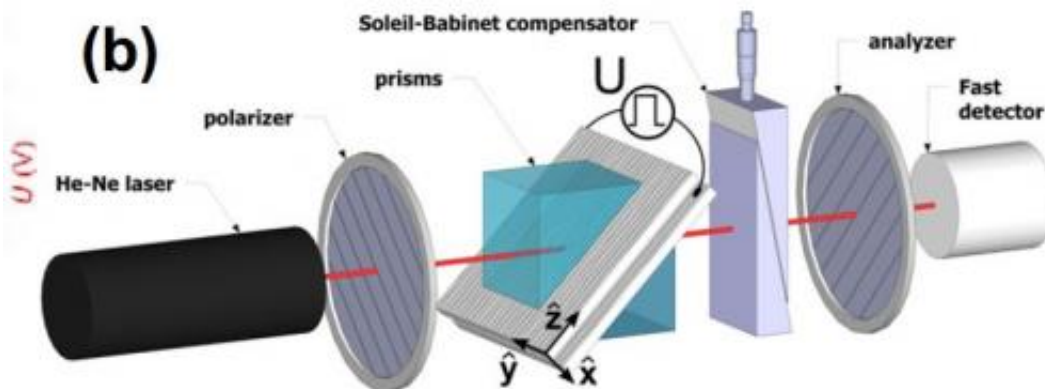


Researchers discover a way to switch liquid crystals off faster

September 9 2013, by Bob Yirka



Experimental setup: NLC cell sandwiched between two 45-degree prisms.
Credit: Volodymyr Borshch et al.

(Phys.org) —A team of physicists at Kent State University has discovered a way to cause liquid crystals to relax to their natural state faster. The result, the team explains in their paper published in *Physical Review Letters*, is a Liquid Crystal Display (LCD) display device that has much faster change rates than conventional LCDs.

LCDs, have of course, become widely popular as the display type of choice for computers, smartphones and [handheld devices](#)—they form the most basic part of such screens, the pixels. Each pixel is made up of a sandwich of liquid crystals set between pairs of glass plates—one of which polarizes light shone from behind. Light movement is controlled

by turning on or off a small electric charge to cause the crystals to rotate a little bit or to relax. With state of the art technology, rotating the crystals happens very quickly when current is applied—it's the relaxing back to their natural state that occurs relatively slowly. In this new effort, the researchers found a way around this problem by using crystals that don't need to be rotated to control the way light is allowed to pass through, or not.

The solution was found in using a type of molecule called CCN-47 as the basis for the crystals—when placed together in a solution they naturally align in a perpendicular fashion. This meant that they wouldn't have to be rotated to change light passing through. Instead, they found that using such molecules as the basis for crystals meant that the [polarization](#) of the light could be rotated (by changing the way the electric field was applied) instead of the crystals—a much faster process. Testing showed the relaxation state could be achieved in just 30 nanoseconds instead of the usual several [milliseconds](#).

The researchers don't expect this new type of LCD to replace those now used for common display devices—those are now fast enough that any gains in speed would not be noticeable to the human eye. Instead, they believe the new types of LCDs might be used to make new kinds of lasers for use in satellite communications or perhaps in cameras.

More information: Nanosecond Electro-Optic Switching of a Liquid Crystal, *Phys. Rev. Lett.* 111, 107802 (2013)

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Abstract

Electrically induced reorientation of nematic liquid crystal (NLC) molecules caused by dielectric anisotropy of the material is a fundamental phenomenon widely used in modern technologies. Its Achilles heel is a slow (millisecond) relaxation from the field-on to the

field-off state. We present an electro-optic effect in an NLC with a response time of about 30 ns to both the field-on and field-off switching. This effect is caused by the electric field induced modification of the order parameters and does not require reorientation of the optic axis (director).

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