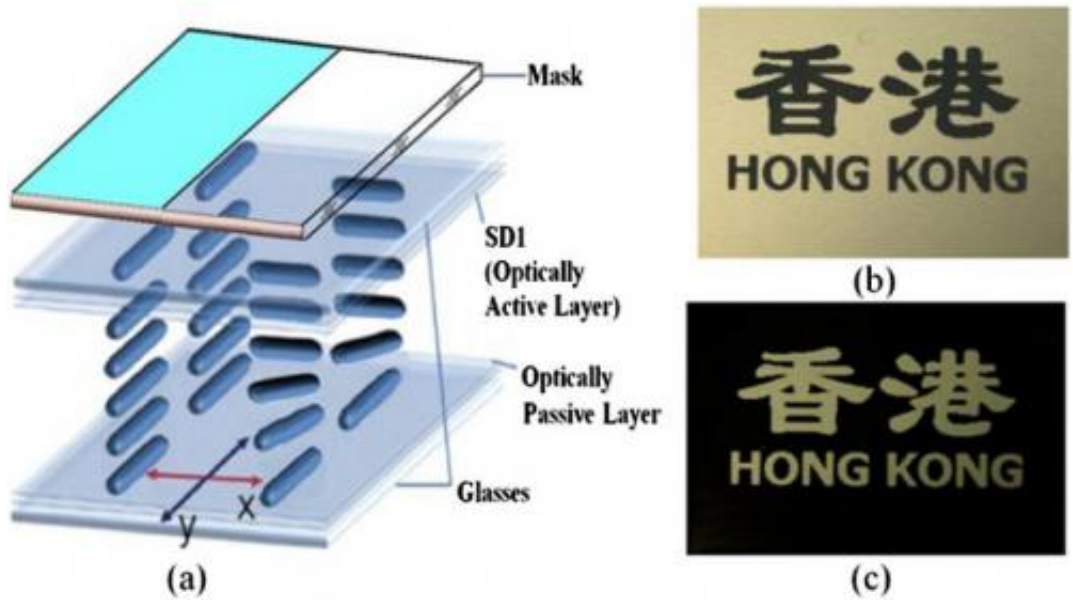
LCD technology maintains 3D images it displays without drawing power

October 22 2014



Credit: Optical Society of America

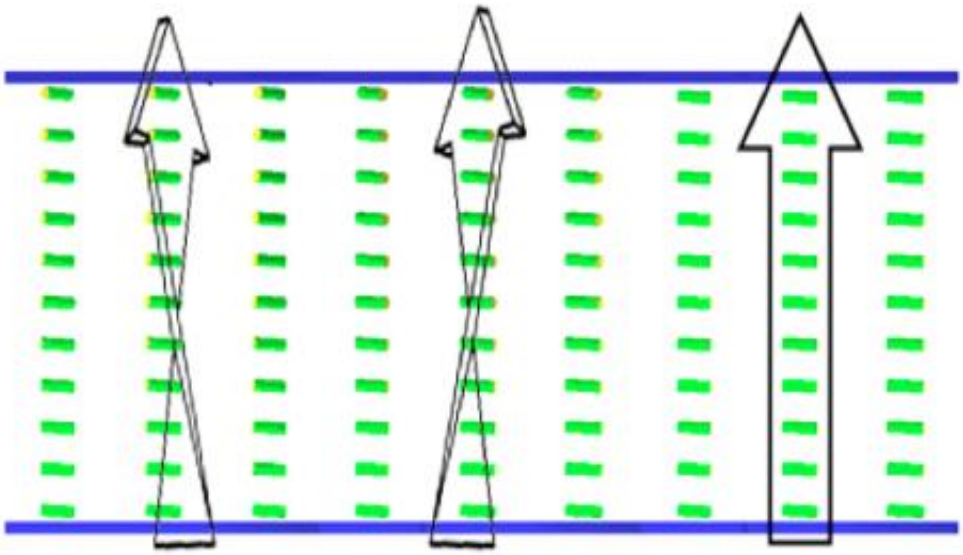
At first glance, the static, greyscale display created by a group of researchers from the Hong Kong University of Science and Technology, China might not catch the eye of a thoughtful consumer in a market saturated with flashy, colorful electronics. But a closer look at the specs could change that: the ultra-thin LCD screen described today in a paper in The Optical Society's (OSA) journal *Optics Letters* is capable of holding three-dimensional images without a power source, making it a compact, energy-efficient way to display visual information.

Liquid crystal displays (LCDs) are used in numerous technological applications, from television screens to digital clock faces. In a traditional LCD, liquid crystal molecules are sandwiched between polarized glass plates. Electrodes pass current through the apparatus, influencing the orientation of the liquid crystals inside and manipulating the way they interact with the polarized light. The light and dark sections of the readout display are controlled by the amount of current flowing into them.

The new displays ditch the electrodes, simultaneously making the screen thinner and decreasing its energy requirements. Once an image is uploaded to the screen via a flash of light, no power is required to keep it there. Because these so-called bi-stable displays draw power only when the image is changed, they are particularly advantageous in applications where a screen displays a static image for most of the time, such as e-book readers or battery status monitors for electronic devices.

"Because the proposed LCD does not have any driving electronics, the fabrication is extremely simple. The bi-stable feature provides a low power consumption display that can store an image for several years," said researcher Abhishek Srivastava, one of the authors of the paper.

The researchers went further than creating a simple LCD display, however —they engineered their screen to display images in 3D. Real-world objects appear three-dimensional because the separation between your left eye and your right creates perspective. 3D movies replicate this phenomenon on a flat screen by merging two films shot from slightly different angles, and the glasses that you wear during the film selectively filter the light, allowing one view to reach your left eye and another to fall on your right to create a three-dimensional image.



In this concept of a LCD display, light is twisted in different directions to make the image appear three-dimensional. Credit: Abhishek Kumar Srivastava

However, instead of displaying multiple images on separate panels and carefully aligning them—a tedious and time-consuming process—the researchers create the illusion of depth from a single image by altering the polarization of the light passing through the display. They divide the image into three zones: one in which the light is twisted 45 degrees to the left, another in which it is twisted 45 degrees to the right, and a third in which it is unmodified. When passed through a special filter, the light from the three zones is polarized in different directions. Glasses worn by the viewer then make the image appear three-dimensional by providing a different view to each eye.

This technology isn't ready to hit the television market just yet: it only displays images in greyscale and can't refresh them fast enough to show a film. However, Srivastava and his colleagues are in the process of optimizing their device for consumer use by adding color capabilities and improving the refresh rate. The thin profile and minimal energy

requirements of devices could also make it useful in flexible displays or as a security measure on credit cards.

More information: "Optically Rewritable 3D Liquid Crystal Displays," J. Sun et al., *Optics Letters*, Vol. 39, Issue 21, pp. 6209-6212 (2014). www.opticsinfobase.org/ol/abst … fm?uri=ol-39-21-6209

Provided by Optical Society of America