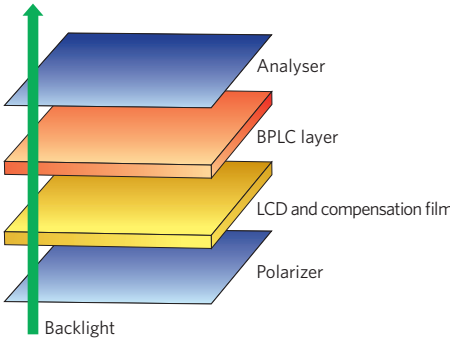
Private viewing

Opt. Express **18,** 3143–3148 (2010)



A new method of controlling the viewing angle of a liquid-crystal display (LCD) promises greater privacy to users of mobile phones and laptops. By inserting a blue-phase liquid-crystal (BPLC) layer into an LCD, Shin-Tson Wu and colleagues from the University of Central Florida, USA, were able to tune the viewing angle of the display continuously when adjusting an applied voltage.

According to Wu, the BPLCs have submillisecond response times, enabling the user to switch from a wide viewing angle to a narrow one quickly. The BPLC layer is also easy to incorporate, as it is simply inserted above or below the LCD and does not require an alignment layer. Simulations were performed on a nematic in-plane switching cell, but Wu is confident that the set-up will operate in all display modes without affecting transmittance. "As long as the LCD is initially well compensated, the viewing angle can always be controlled by the applied voltage of the inserted BPLC layer," he explains. "This method has a larger aperture ratio and higher optical efficiency than other techniques, although we now want to widen the tuning range and lower the operating voltage."

Image sticking

Appl. Phys. Lett. **96,** 043504 (2010)

Plasma display panels (PDPs) suffer from temporal image sticking, whereby a faint outline of a previous image remains visible on the screen after the image has changed. Researchers from Kyungpook National University, Korea, have now identified why this happens and how to stop it.

According to Heung-Sik Tae, temporal image sticking is due to organic impurities that remain on the MgO protective layer in the PDP. The vacuum ultraviolet discharge during PDP operation dissociates the impurities into carbon and hydrogen, and the hydrogen then combines with oxygen from the MgO surface to form water, which causes the sticking.

To minimize sticking, Tae and his colleague treated the MgO layer of a 50-inch, high-definition, alternating-current PDP with radiofrequency plasma. Experiments with several gas compositions indicated that treatment with an argon plasma was most effective at preventing impurity build up.

"Organic matter on the MgO layer was remarkably reduced compared to the panel that didn't have this plasma pre-treatment," says Tae. "The display luminance difference was considerably reduced, meaning no temporal image sticking." Tae asserts that the plasma treatment can be used on a commercial scale. "Thanks to fewer impurities, the treatment considerably reduces the panel ageing time," he said. "This would reduce the cost of a PDP panel despite radiofrequency plasma equipment costs."

Fast e-book readers

Appl. Phys. Lett. **97,** 023514 (2010)

Researchers from the University of Cincinnati, USA, have demonstrated, for the first time, a colour electrowetting display device based on a vertical-stack pixel structure. Producing higher resolution images than conventional layouts and with typical switching speeds of 10 ms, the design holds promise as a display for video-compatible colour e-book readers. Most e-book readers use low-power electrophoretic displays, but their low switching speeds are not compatible with displaying animation and video. In contrast, the electrowetting reflective display offers video-rate switching speeds, although current designs require the use of an overlay colour filter, limiting resolution. Now Andrew Steckl and colleagues have adopted an approach in which three pixels, filled with coloured oils, are stacked on top of each other. Arrays with as many as 1,000–2,000 pixels were fabricated. "The device has smaller effective pixel sizes than conventional layouts, leading to potential higher resolutions," says Steckl. "We don't need colour filters, which is a big plus, but must have good vertical alignment between pixels." The team says that it now plans to improve colour saturation using different dyes. "We also want to develop larger arrays and use flexible substrates for the e-book reader market," adds Steckl.

Speckle reduction

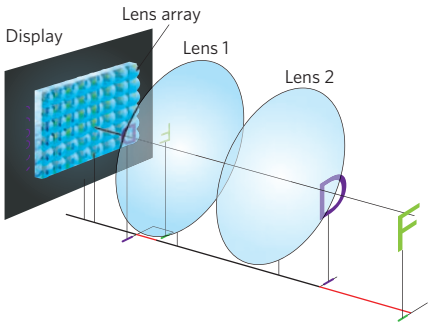
J. Opt. Soc. Am. A **27,** 1812–1817 (2010)

Rear-projection laser displays deliver colourful images with unprecedented resolutions, but 'laser speckle', an interference pattern generated at the screen, has delayed commercial adoption. A recent method reduces the problem by using a small rotating plate to diffuse the light before it passes through a microdisplay and is projected on a screen. Tatsuo Uchida and colleagues from Tohoku University, Japan, performed experiments to determine how speckle is reduced using such a set-up. They identified two occurrences of speckle in the system, the first at the rotating plate and the second at the screen. Further investigations revealed that when the plate was rotated, the granular pattern of speckles generated there corresponded to coherent regions of the secondary speckle, at the screen. The researchers then measured the speckle contrasts at the screen by changing the degree of granularity of the primary speckle.

"In every case, as granularity increased, the corresponding speckle contrast increased," says Uchida. "This shows the degree of granularity of the primary speckle is the key parameter in speckle generation on the screen, and can be used as a unified index when discussing speckle reduction effects."

Floating 3D images

J. Soc. Inf. Disp. **18,** 519–526 (2010)



Floating image displays typically use a single large lens or two closely located Fresnel lenses to create a 3D image that literally floats in front of the viewer. However, plane projections suffer from barrel distortion, looking curved. Researchers from Chungbuk National University, Korea, have now devised a 'double-floating-lens' system, in which the distance between two lenses is equal to the sum of their focal lengths. According to Nam Kim and Jae-Hyeung Park, this set-up compensates for barrel distortion and ensures constant magnification across the image. The researchers also combined the lenses with a 3D integral imaging display, comprising a liquid-crystal display and a lens array, to display images in full colour. "Previous systems have tried to compensate the distortions and non-constant magnification by applying pre-distortion to the integrated images. This has not been effective so we developed a system to eliminate distortions optically," says Park. The researchers are now working on expanding the viewing angle of the system.