Grating microdot to boost backlighting

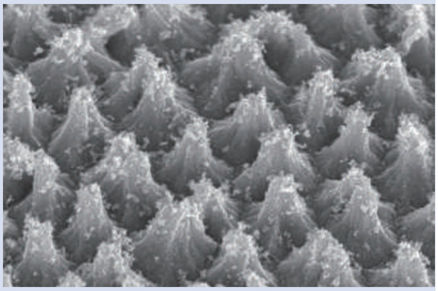
Opt. Express **15,** 2888–2899 (2007)

As the demand for power-efficient and light-weight LCDs with high image quality grows, the need for backlight units (BLUs) with better performance increases. Backlight units based on LEDs potentially provide an answer due to their high colour range and long life time. However, in order to compete effectively with cold-cathode fluorescent lamps, LED-BLU problems, such as luminance non-uniformity and hot-spots, need to be overcome. Having recognized this, a group of Korean researchers has developed an LED BLU based on a light-guide plate featuring a two-dimensional array of grating microdots. Seung Ryong Park and colleagues use dot-matrix holographic lithography and UV embossing replication to fabricate the submicrometre-period grating dots. The experiment suggests that their microdot LED BLUs offer a highly uniform light distribution within around 8° and 20° luminance angles without identifiable hot spots. In addition, their fabrication technique is scalable and thus suitable for producing large arrays of microgratings for use in large BLUs.

Nanorods enhance nanotube field emission

[1]*Nanotech.* **18,** 155702 (2007)
[2]*Nanotech.* **18,** 065203 (2007)

Carbon nanotubes (CNTs) are now attracting much attention for use as electron emitters in field-emission displays, especially for large-area panel displays. Research around the world is now striving to obtain a higher emission current density, larger emission area and lower threshold field. Now, a group of Chinese researchers led by Chun Li have demonstrated that CNT bundle arrays grown on vertical self-aligned ZnO nanorods can offer enhanced field emission[1]. The combined nanostructures have a reported current density of 1 mA cm^{-2} at an electric field of 4.5 V μm^{-1} with a turn-on field of 1.5 V μm^{-1}. The researchers have attributed this to the low work function and high aspect ratio of the CNTs and the large surface-to-volume ratio of the underlying ZnO nanorods. Elsewhere, Xin Jian Li and Wei Fen Jiang from Zhengzhou University, China, have reported a large-scale nest array of multiwalled CNTs. Integrated on a silicon nanoporous pillar array, the approach provides a current density of 6.8 mA cm^{-2} at an electric field of 3.1 V μm^{-1} with a turn-on field of 0.56 V μm^{-1} (ref. 2). The researchers comment that the excellent performance is due to the unique structure and morphology of the array. Both approaches suggest that incorporating CNTs into nanostructures paves the way to improved field-emission panel displays. Integration of CNTs into arrays of pillars or nanorods has lit the way towards enhanced performance.



LCD offers controllable viewing angle

Appl. Phys. Lett. **90,** 101104 (2007)

Most LCDs have a limited and fixed viewing angle, with contrast and colour degrading if the screen is seen outside a certain range. At present, wide viewing angles are commonly required for general display purposes, whereas narrow viewing angles are desired when it comes to personal security applications. Although the use of multiple liquid-crystal layers and dual backlight systems can help control the viewing angle, these approaches require additional components and cost. Now, researchers from Pusan National University of Korea have proposed a single-panel, single-backlight system that offers an adjustable viewing angle. Jong-In Baek and colleagues have found that the solution to this problem is to control the dark state of LCDs in two different ways (one for wide-angle viewing and one for narrow-angle viewing) by aligning liquid-crystal layers parallel or vertical to the transmission axis of a bottom polarizer. The researchers demonstrate that this, so-called dual-mode-switching method offers a controllable viewing angle while giving a good contrast ratio for both narrow and wide viewing-angle modes.

Antireflective grating exploits nanostructures

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Conventional antireflective films with single-layer or multilayer coatings are commonly used for reducing the reflection and glare from the front panels of displays. Coatings based on relief structures with a period shorter than the incident-light wavelength show much promise, but their use is hindered due to the difficulty in fabricating such small periodic grooves. Now, Testuya Hoshino and colleagues from the University of Tsukuba propose an antireflective grating with a period greater than the incident-light wavelength. They use a simulation tool to evaluate the diffracted-angle distribution, the total transmission and the total reflection of the grating. Based on numerical analysis, they report a total reflectivity of 0.2% for the blazed grating, with an aspect ratio of one and with a period larger than nine times the incident-light wavelength. The advantage of their studied grating is that it has both diffusion and antireflection functions in one layer and that the diffraction efficiency and transmission change only a little with wavelength.

LED projectors give portable answer

Appl. Opt. **46,** 522–526 (2007)

A pocket-sized projector based on an LED illumination system could be the answer to providing 15- to 20-inch images with a brightness comparable to a laptop screen, according to scientists in China. Xing Zhao and co-workers have now designed and simulated, by ray tracing, the performance of such a system based on high-power red, green and blue LEDs (Luxeon III from Lumileds). Additional components include three collimators, an X cube (a commonly used element for colour mixing), an integrator rod, a prism and a 0.55-inch digital-micromirror-device (DMD) chip. The researchers used LightTools software to trace 1.5 million rays through the system for an incident flux on the DMD of 44 lumens. They conclude that the system has a larger colour range than the standard red, green and blue and in theory could be constructed for around $500–$600. Unlike traditional projectors, it could be much smaller, powered by batteries, offer instant on–off times and generate much less heat. Potential future applications include displaying images from digital cameras, mobile phones and personal digital assistants.