Novel Two Mask AMOLED Display Architecture

Mike Hack, Michael S. Weaver, Woo-Young So, and Julie J. Brown
Universal Display Corporation, 375 Phillips Blvd, Ewing, NJ 08618, USA

Candice H. Brown Elliott
Nouvoyance, Inc., 874 Gravenstein Hwy. South Suite 14, Sebastopol, California, USA 95472

In 2014 [1] we presented a novel AMOLED display architecture that enables the fabrication of AMOLED displays using only two low resolution masking steps, and consumes comparable power, and has improved lifetime, as compared to an equivalent RGB side-by-side AMOLED display using three high resolution patterning steps. We have now further improved the design to enable the mask resolution to be only half that of the resultant display in both x and y directions. This new architecture also increases sub-pixel aperture ratios by only requiring one emissive color layer change per pixel, and therefore only one mask tolerance per pixel. The increased fill factors further improve device lifetimes.

We use only two emissive layer patterning steps of half the display resolution, as compared to three at full resolution in a conventional AMOLED side-by-side (SBS) display. The two OLED depositions are yellow and blue. The blue can be exactly the same blue stack as would be used in a RGB SBS display, and the yellow could either be a broad yellow emission or a combination of red and green. The yellow emissive area is further divided into three sub-pixels, unfiltered yellow emission, and using color filters we produce both green and red sub-pixels. Simulations for a 55" 4K TV show up to x4.8 improvement in blue lifetime may be possible.

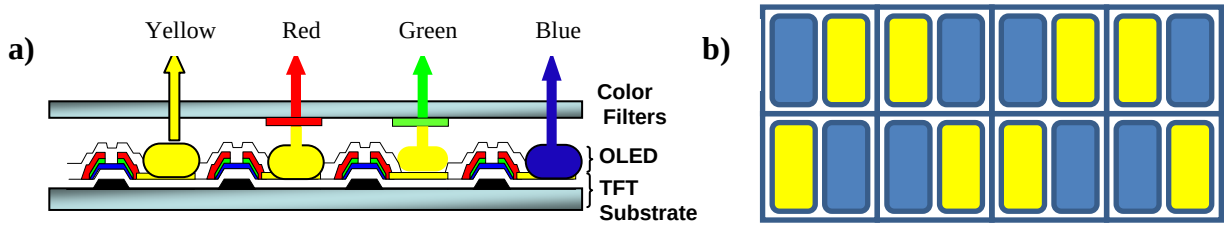

Figure 1 –a) Layout of new two mask pixel architecture showing two OLED depositions (yellow and blue), with red and green produced by color filters placed over the yellow PHOLEDs, and b) sub-pixel arrangement to reduce mask resolution

Further improvements in display performance may be achieved by applying sub-pixel rendering [2]. This enables different resolutions for different colors so as to match the display to the visual performance of the human eye. These techniques allow for a reduction in the number of sub-pixels per pixel, reducing the number of data lines and data drivers. Sub-pixel rendering allows for a four color display but with effectively only 2.25 sub-pixels per pixel, reducing both the number and area of TFTs per pixel.

In summary, our new proposal for fabricating an AMOLED display allows for the following benefits, and therefore cost reduction, compared to a conventional RGB side by side display.

1) Only two emissive layer fine metal mask depositions
2) Fine metal mask has only half the resolution of the display
3) Four primary colors, but less than 3 sub-pixels per pixel.
4) Only one emissive layer color change per pixel
5) High sub-pixel aperture ratio allowing for significant improvement in blue lifetime
6) Similar power consumption to conventional RGB display

References

1) Mike Hack, Michael S. Weaver, Woo-Young So, and Julie J. Brown, SID Digest Vol 45, pp 567-569 (2014)
2) Candice Brown Elliott, "Image Reconstruction on Color Sub-pixelated Displays", chapter 12, Mobile Displays: Technology and Applications, Society for Information Display / Wiley Book Series (2008)