Color-tunable AC/DC OLEDs: A new concept for white light

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We demonstrate an organic light-emitting diode (OLED) concept at which the emission color can be actively adjusted. This is achieved by independently addressing a fluorescent blue and a phosphorescent yellow emission unit that are vertically stacked on top of each other (Fig. 1a). The design of the three electrodes is optimized for simple fabrication and driving. Due to the electrical junction of the bottom and rear electrode, our device allows for two-terminal operation by a single power source.
When direct current (DC) is applied, the device emits -depending on the polarity- either blue or yellow light. Changing the polarity with high frequency, e.g. applying an alternating current (AC) signal, the human eye is no longer able to distinguish between these two colors and the impression of steady, additive mixed light is perceived. As demonstrated in Fig. 1b, the emission can be tuned from deep-blue through cold-white and warm-white to saturate yellow by varying the voltage of the positive and negative half-cycles of the AC signal.
At warm white CIE color coordinates of (0.44/0.45), our AC/DC OLEDs achieve a high luminous efficacy of 36.8 lm/W at 1000 cd/m². We believe that an efficient realization of such a system is an important step toward RGB full-color devices in which three independent emission units are stacked on top of each other. Such a vertically stacked RGB configuration is highly attractive for display applications as it allows for greatly increased pixel densities and a close-to-optimal utilization of the available display panel area for all colors.[2]

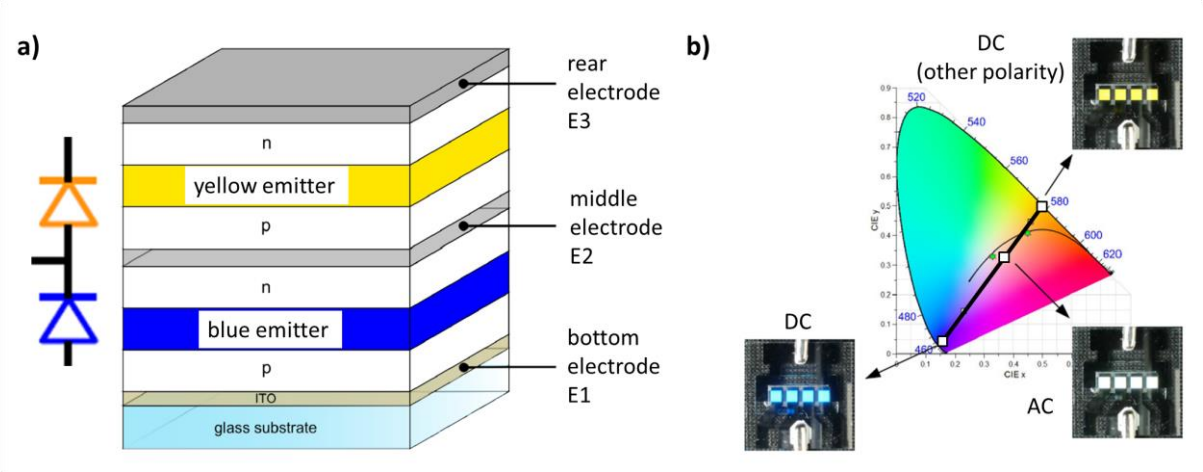

Fig. 1. (a) Schematic illustration of the architecture of the investigated color-tunable AC/DC OLEDs with electrodes. Electrodes E1 and E3 are connected to each other and E2 is the independent counter electrode. (b) Color coordinates of the AC/DC OLED. A square-wave signal is used to tune the emission color by varying the ratio between the voltages applied during the forward and backward pulses.

Reference

1. M. Fröbel, T. Schwab, M. Kliem, S. Hofmann, K. Leo, and M. C. Gather, Get it white: color-tunable AC/DC OLEDs, Light: Science & Applications 4 (2), 247 (2015)

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