Impact of Different Gate Dielectrics on OTFT-Driven Active Matrix OLED Pixel Circuits

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Low-voltage operation of organic thin-film transistor (OTFT) are mainly affected by several engineering process parameters at the few-nanometre organic semiconductor thickness of the channel and the gate dielectric interface. Taking this factor into the consideration, the impact of different gate dielectric material onto the low-voltage OTFT-driven active-matrix organic light-emitting diode (AM-OLED) is investigated. Moreover, the impact of hexagonal boron nitride (h-BN) 2D, polymethyl methacrylate (PMMA) organic, hafnium oxide (HfO2) inorganic, and stack dielectric materials on the conventional 2T1C pixel circuits is examined and compared through mixed-mode circuit simulation. The results show that gate dielectric stacking on the performance of pixel circuits design to overcome mobility degradation due to dipole disorder at the interface of thin film and dielectric as well as faster charging and discharging due to reduction in the parasitic capacitance is much more improved. The maximum OLED current achieved through stack dielectric-based pixel circuit is $0.6\,\mu$A. This methodical approach subsequently will be helpful in identifying the device in OLED display technologies.

Keywords: switching performance, high-*k* dielectric, low-*k*-dielectric, organic light-emitting diode (OLED), stack dielectric, active-matrix OLED pixel circuit.

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