Organic Light Emitting Transistors: towards the next generation active matrix display technology

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Organic light-emitting transistors (OLETs) represent a novel class of organic devices capable to combine the current modulating function of a transistor with light emission, and could pave the way towards nanoscale light sources and highly integrated organic optoelectronics. By directly comparing the vertical diode architecture of OLEDs with the planar transistor structure of OLETs, it is clear that organic light emitting transistors have the potential to enhance the optoelectronic performances of the photonic components, while preserving the simplicity of the system architecture at potentially lower production costs.

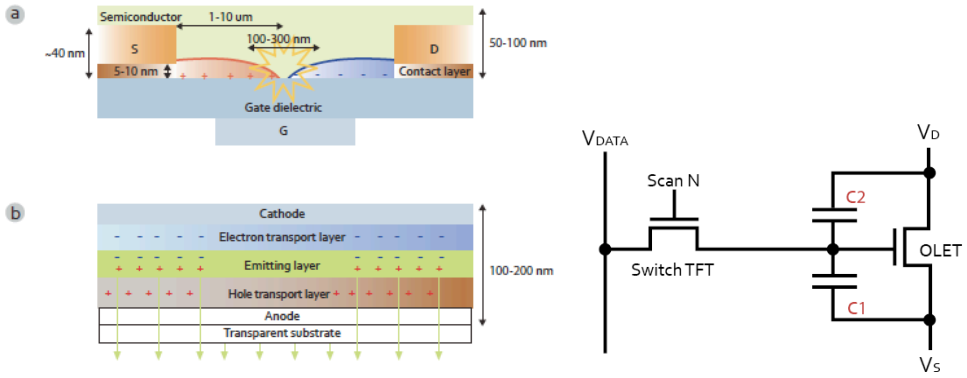

Fig. 1. Schematic representation of the device structures and of the main optoelectronic processes occurring in an OLET and in an OLED. a, Electron and hole charge transport occurs in-plane at the dielectric/organic interface in OLETs. b, Charges move vertically across the organic layers in OLEDs. Right, basic structure of the AM-OLET pixel. Only one transistor is used to switch the OLET, while the capacitance of the source and drain electrodes of the OLET provide the memory effect of the pixel.

Given the recent results in the fabrication of bright, efficient and reliable devices, it is expected in the near future that the full compatibility of field-effect light-emitting devices with well-established electronic and photonic planar technologies will allow the development of viable technological solutions in various application field, including display technology and sensing. In particular, OLETs may constitute a key element for the development of next-generation organic active matrix display technology. The increase in pixel brightness and lifetime due to an unparalleled control of charge injection and accumulation in the organic layer, the combination in a single device of the electrical switching and light-emission functionalities, which reduces the number of switching thin-film transistors to be realized in the active matrix driving circuit, and the gate voltage modulation of the light emission, which enables the use of lower quality TFT backplanes, make OLETs a potentially breakthrough technology for display applications.
It is worth noting that the potential of OLETs for Flat Panel Displays stems from fundamental architectural features. The possibility to combine an OLET frontplane with any available backplane technologies, including low cost a:Si-TFT and rollable OTFT, is a game changer for the field of active matrix displays.

References

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