OTFTs for conformal, low power, wearable displays

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The last few years have seen major advances in the field of flexible displays. Many device manufacturers are planning smartphones and tablet computers with truly flexible displays. The challenge for display makers is to develop reliable and stable materials that are also fully flexible. Currently, IGZO [1,2] and LTPS [3] are seen as front runners in new device backplane technology; however these materials suffer from poor flexibility in addition to poor bias stress stability (IGZO) and poor leakage/off-current (LTPS). Organic thin film transistors (OTFTs) are now achieving mobilities that make them suitable for commercial applications. In addition, improved materials and processing have also lead to enhancements in off currents, stability and uniformity.

For OTFT devices fabricated with SmartKem's *tru*-FLEX® organic semiconductor, off currents of $1x10^{-16}$ A /µm have been achieved using a single gate (TGBC) structure (normalised to L=W=1 µm), as shown in fig 1. When a dual gate structure is employed (as is commonly the case for IGZO TFT devices [1]) a further reduction in off-current is observed along with an additional improvement in V_{th}. When extended to models of battery lifetime, a considerable improvement may be observed when compared with devices incorporating LTPS backplanes. In addition, SmartKem OTFTs were subjected to a variety of stress conditions and the before-and-after performance compared. Subjecting the devices to a voltage stress of +30 V for 2000s resulted in a V_{th} shift of only +0.3 V, while subjecting them to a current stress (V_{gs}=-30V, V_{ds}=-30V) for 1000s resulted in a V_{th} shift of -0.14 V. In thermal stress tests, a V_{th} shift of only +0.55V was obtained after heating at 150°C for 120 minutes.

In this presentation, the stability of OTFTs fabricated with SmartKem *tru*-FLEX® will be demonstrated with recent results in low off-current being discussed in terms of the extended battery life for mobile devices.

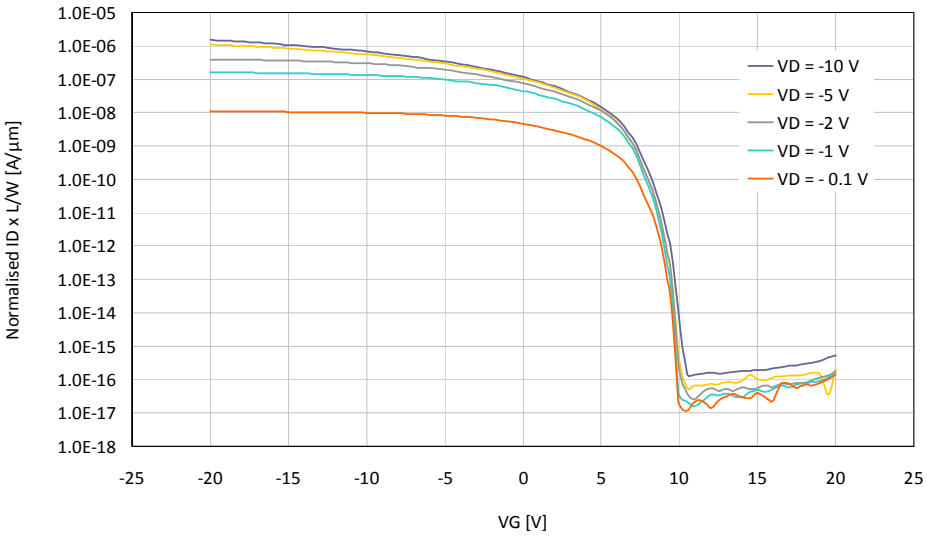

Fig. 1. Normalised output curves obtained for OTFT devices fabricated with SmartKem *tru*-FLEX®

References

1. M. Mativenga, D. Geng and J. Jang, *SID 2014 Digest*, vol. 45, p. 1 (2014)
2. T. Matsuo, S. Mori, A. Ban and A. Imaya, *SID 2014 Digest*, vol. 45, p. 83 (2014)
3. H. Ohshima, *SID 2014 Digest*, vol. 45, p. 75 (2014)