9:30 AM *G13.4

The Quest for the TFT Fountain of Youth. James Sturm, B. Hekmatshoar, K. Cherenack and S. Wagner; Princeton University, Princeton, New Jersey.

For flexible products, the stability of thin film transistor (TFT) performance is a critical requirement. This is especially so for cases when the transistor operates in a DC analog condition (e.g. driving an OLED), as opposed to a pulsed condition as a digital switch (as in active matrix addressing). In most technologies, the shift in the threshold voltage is a more severe problem than changes in mobility. In this talk, we first review the main mechanisms which cause drift in the threshold voltage: charge trapping in the gate insulator, ion drift in the insulator, and defect formation in the semiconductor. Different mechanisms dominate under different gate voltages and times of operation, and can be isolated through a "phase diagram" approach. Defining lifetime as the time for the current to decay by 50% (similar to 50% luminescence decay for OLED lifetime), and assuming operating conditions in a realistic OLED pixel at 1000 nits brightness, "standard" a-Si TFT's on glass have lifetime of ~1 month. With knowledge of the critical mechanisms, we show how a-Si TFT materials can be improved to reach a DC lifetime on clear plastic of ten years and far longer on glass. Second, comparing TFT stability across different technologies and different results is difficult because the threshold voltage shift depends by orders of magnitude on gate insulator thickness, gate voltage, FET geometry, current levels, etc, as does the effect of the threshold shift on the TFT current. Therefore, we define a framework for making useful stability comparisons from a high-level circuit designer's point of view, as one might use to decide between technology choices for next generation products. Within this framework we then compare a-Si TFT's to available data for organic and metal-oxide TFT's, and relate trends in these curves to the fundamental mechanisms described above. The support of the United States Display Consortium is gratefully acknowledged.