Abstract

Organic transistors have shown immense potential to be used in flexible, large-area, and low-cost electronic systems, such as pixel drivers in active-matrix organic light-emitting diode displays. However, there are many performance and stability issues to be addressed before these transistors can be employed in the circuitry of commercial systems. The main performance issues are low field-effect mobility and high operating voltage, whereas the stability issues are the degradation of the device characteristics upon exposure to ambient air or to electrical stressing.

In this work, low-voltage flexible p-channel and n-channel organic transistors are demonstrated using six promising organic semiconductors. These high-performance organic transistors were subjected to various bias-stress conditions to analyze and compare the electrical stability. A comprehensive study of the environmental and electrical stability was conducted. The benchmarking of these organic TFTs is done with various technologies with respect to the channel sheet resistance and the 10%-current decay lifetime of TFTs. Some of the flexible organic transistors, processed at lower temperature show higher lifetimes as compared to those of a-Si:H TFTs, during bias-stress stability study.

The primary reason for the bias-stress effect in organic transistors is the trapping of charge-carriers. One of the techniques to quantify the trapping of charge-carriers is the displacement current measurement. Long channel-capacitors were fabricated using four different organic semiconductors and four different contact metals in order to measure the number of charge-carriers injected into and extracted from the organic semiconductor, along with the density of trapped charges in the device, in order to better understand the trapping dynamics in organic transistors.