Low Voltage, Printed, Flexible Circuits for Display and Memory

Mingjing Ha[1], Wei Zhang[2], Daniele Braga[1], Michael J. Renn[3], Chris H. Kim[2], C. Daniel Frisbie[1]; [1]Department of Chemical Engineering and Materials Science, University of Minnesota, [2]Department of Electrical and Computer Engineering, University of Minnesota, [3]Optomec, Inc., (USA)

Abstract

Printed organic electronics have received increasing interest in connection with large area, flexible macroelectronics applications. In this poster, we demonstrate the printed, flexible circuits can be used for display applications, such as driving the electrochromic display or organic light emitting diode (OLED) at a low supply voltage (< 2 V). We also report a printed DRAM matrix (8×8 array) with a long retention time (> 60 s), which can be potentially combined with the display pixel array to achieve large area applications. The circuit was fabricated by aerosol jet printing of semiconducting, metallic and insulating inks. To achieve the low voltage operation, the printed dielectric consists of a gel electrolyte based on a high capacitance ionic liquid and block copolymer composite. Because of the very high capacitance (>10 μF/cm^2) of the ion gel, the operation voltage of the printed circuit with a coarse channel dimension (20 μm) can be as low as 1 V. A fast digital circuit is also demonstrated by using printed high mobility (> 20 cm^2/Vs) semiconducting carbon nanotubes (CNTs). A 5-stage ring oscillator achieves frequencies > 2 kHz (stage delay time ~ 50 μs) at supply voltages of 2.5 V. This performance represents a substantial improvement for printed circuitry.