The Organic Power Transistor: Roll-to-Roll Manufacture, Thermal Behavior, and Power Handling When Driving Printed Electronics

We present flexible organic power transistors prepared by fast (20mmin1) roll-to-roll (R2R) flexographic printing[1] of the drain (D) and source (S) electrode structures directly on polyester foil. The devices have top gate architecture and were completed by spin coating or slot-die coating of the organic semiconductor poly-3-hexylthiophene (P3HT) and the dielectric material polyvinylphenol (PVP) before the gate (G) was applied by either screen printing or evaporation of silver. We explore the footprint and the practically accessible geometry of such devices with a special view toward being able to drive large currents while handling the thermal aspects in operation together with other organic printed electronics technologies such as large area organic photovoltaics (OPV)[2] and large area electrochromic displays (EC).[3] We find especially that an elevated operational temperature is beneficial with respect to both transconductance and on/off ratio. We achieve high currents of up to 45mA at a temperature of 80°C with an on/off ratio of 100 which is sufficient to drive large area organic electronics such as an EC device powered by OPV devices that we also demonstrate. Finally, we observe a significant temperature dependence of the performance which can be explored further in sensing applications.