Transparent and flexible transistors with organic materials

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Fully flexible and transparent n-type and ambipolar all-organic organic field effect transistors (OFETs) can be realized by a double layer of pentacene and C60 as semiconductors. Electrical contacts can be poly(ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS). Growing C60 on a pre-deposited pentacene buffer layer leads to a clear improvement in the morphology and crystallinity of the film allowing to obtain n-type conduction despite the very high electron injection barrier between PEDOT:PSS and C60. As a result, it is possible to realize n-type and ambipolar all-organic OFETs that can be operated in air by optimizing the thicknesses of the pentacene buffer layer [1].

For oligothiophene-based OFETs, a practical method will be introduced for controlling the transport properties by using active layers comprised of a mixture of two organic semiconductors that: i) have a different ionization energy (which results in different charge injection barriers towards the source contact and to a different affinity towards doping by oxygen), and ii) can uniformly intercalate over a wide variety of molar ratios on various substrates. The key effect is a control over mobile carrier density in the OFET channel region by oxygen doping, which can be linearly adjusted by the mixed layer composition. This is particularly relevant for the practical application of organic semiconductors in plastic electronics. The working point (depletion or enhancement mode) of transistors can thus be regulated for any given oxygen concentration of the environment that prevails during OFET fabrication by simply adjusting the ratio of the two molecular materials that form the channel [2].

[1] P. Cosseddu, A. Bonfiglio, I. Salzmann, J. P. Rabe, N. Koch, *Org. Electron.* 9 (2008) 191.

[2] P. Cosseddu, J.-O. Vogel, B. Fraboni, J. P. Rabe, N. Koch, A. Bonfiglio, *Adv. Mater.* 21 (2009) 344.