Organic Thin-Film Transistors Adressable by Light

Organic semiconductors are key components for the development of printable, flexible, and large-area electronics. To realize complex device functions the materials should exhibit several (meta-stable) states, between which can be switched selectively with different stimuli ("addressing"). Amongst possible stimuli, light is very attractive as it provides unprecedented spatio-temporal control and can be easily interfaced with advanced optics. However, in order to introduce light-responsiveness in organic devices photoswitchable molecular building blocks have to be incorporated into the material, ideally in a convenient and practical process. An international research team including Stefan Hecht and Norbert Koch – both members of IRIS Adlershof – has now realized such “smart“ transistors that can be addressed by light. As described in their article in Nature Chemistry the authors demonstrated a new concept by introducing photoswitchable electron-hole traps into the active layer of the device. These specifically designed small molecules are able to interfere with the charge flow through the transistor’s semiconducting polymer in one particular state, which is generated by illumination with UV-light. Illumination with visible light disables the traps and re-establishes the initial state, in which charge flow is not affected (see Figure).

The new method of simple blending of trap molecules with the semiconductor matrix is highly effective yet simple, and hence applicable to large-scale device fabrication processes. The light-programmable transistors could serve as multifunctional elements in logic circuits.

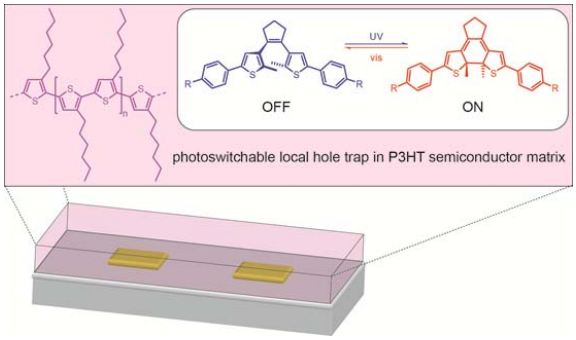

Figure: “Smart“ transistors gated by light: UV-illumination transforms ring-open dithienylethene (blue) to its ring-closed isomer (red), which effectively traps holes in the semiconducting poly(3-hexylthiophene) (P3HT) matrix. Illumination with visible light reverts the process and reinstalls charge flow through the device.

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