Ultrasmall transistor-based light sources

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Organic nanofiber: Fabrication and integration

The organic nanofibers are fabricated under ultra high vacuum conditions. This fabrication involves evaporating the organic molecules onto a freshly cleaved of muscovite mica, where the molecules self assemble into nanoscale fibers.

Previous work has shown how these fibers can be transferred to bottom gate/top electrode transistor substrates in order to realize a nanofiber-based transistor. See Figure 1.

p6P

The p6P molecule is a linear chain of six phenylene groups. See Figure 2. Organic p6P nanofibers fluoresce highly polarized blue light when exited by UV light. See Figure 3.

Excited by UV-light the p6P fluoresce in the blue part of the spectrum. An example of such a spectrum is shown in Figure 6. The spectrum contains several peaks corresponding to transition between vibronic states in the p6P molecule.

Photoluminescence

Excited by UV-light the PPTTPPP fluoresce in the green part of the spectrum. An example of such a spectrum is shown in Figure 7. The spectrum contains several peaks corresponding to transition between vibronic states in the PPTTPPP molecule.

Electroluminescence

For both p6P and PPTTPPP fibers electroluminescence has been observed. During the EL experiments the OLET are kept under vacuum conditions and the EL is observed (in black an white) with an Electron Multiplying Charge Coupled Device (EMCCD). In order to obtain EL an AC voltage is applied to the gate of the OLET while the drain and source electrode are grounded. See Figure 8.

EL emission from p6P and PPTTPPP fibers electroluminescence has been observed. During the EL experiments the OLET are kept under vacuum conditions and the EL is observed (in black an white) with an Electron Multiplying Charge Coupled Device (EMCCD). In order to obtain EL an AC voltage is applied to the gate of the OLET while the drain and source electrode are grounded. See Figure 8.

Conclusions and further investigations

The coal of obtaining the multicolored (in this case blue and green) seems possible within a very near future. If EL is obtained from both types of fibers on the same substrate it should be possible to separate the luminescence by using short- and longpass filters. Figure 11 shows the electroluminescence from p6P and PPTTPPP fibers together with the transmission of a shortpass filter (cut-off: 500nm) and a longpass filter (cut-on: 500nm). Here it seems how using optical filters can separate light from the two types of fibers. This is assuming that the electroluminescence spectrum coincides with the photoluminescence spectrum of both fibers. This has been demonstrated for p6P. Another aspect of the nanofiber based OLETs is the low efficiency with which the devices. Attempts to improve this could involve a self-assembling monolayers between nanofibers and the electrodes of the transistor. This have in some cases been shown to improve charge injection. Another improvement could originate from a change of gate dielectric medium.

References