Popular scientific abstract

The research field of optoelectronic has, for half a century, been dominated by inorganic materials. However, there has been a raise in organic nanotechnology in the past decade, because of the ability to synthesize organic molecular building blocks with desired properties that can lead to new or improved functionalities for devices based on small organic molecules. For future nanophotonic or -optoelectronic systems, phenylene- and thiophene-based molecules are of particular interest due to their ability to self-assemble into crystalline nanofibers. These can then act as nanoscale components in larger devices. To establish electrical contact to the nanofibers, these have to be integrated with the necessary circuitry. For this, field-effect transistor devices can be used for the realization of a so-called organic light-emitting transistor. Recently organic nanofibers have been integrated on a transistor substrate, via a roll-printing method, to establish electrical contact and light emission has been obtained. However, the light generation process for nanofibers-based devices is still not completely understood and the light emission is also weak.

In this thesis, a roll-printing integrating method is further developed to fabricate a variety of nanofibers-based devices by varying the nanofibers and device configurations. Three different types of organic nanofibers have been used. The color of the emitted light can be varied, simply by changing the nanofiber used.

The mechanism for the light emission has been studied for entire devices with many nanofibers and for single nanofibers. These investigations show that devices made from the three different types of nanofibers exhibit slightly different driving voltages for emitting light, but that the overall operating mechanism is the same. Investigations have also revealed that nominally similar nanofibers form interfaces with different electrical contact. Morphology investigations of the integrated nanofibers, suggests that size of the nanofiber is important, but not crucial, to the formation of a good electric contact. Light emission from the nanofiber-based device has been improved using different methods.

A very promising aspect of the roll-printing method is the possibility of integrating more than one type of nanofibers in one device. By using a double roll-printing scheme, blue and green nanofibers, have been integrated on the same device realizing a multicolored device.