Pattern generation by using high-resolution nanoimprinting and nanotransfer printing techniques

Nanofabrication is the core task performed and constantly further developed by today's and future semiconductor industry. Optimization of throughput and minimizing process cost and complexity thus increasing fabrication reliability constitute the main challenges within this development. Printing techniques play a crucial role in nanofabrication since they are offering the capability of large area patterning while simultaneously holding overall process time shorter than when using any other conventional nanolithography technique. Our work in this field focuses both on the development of new techniques and materials for nanoimprint lithography (NIL) technology as well as on the fabrication of several components for innovative devices and systems for different applications in the area of nano- and molecular electronics. With the aim of pushing the patterning resolution in the sub-10 nm region, we introduce a room-temperature NIL (RTNIL) technique, which uses molds that are fabricated by molecular-beam-epitaxy (MBE). MBE growth processes allow for precisely controlling the thicknesses of grown crystalline
layers with sub-5 nm resolution. This resolution directly determines the minimum size of the mold features to be imprinted. We have designed and built a new NIL-tool that is capable of performing single-step RTNIL using MBE-molds that we fabricated. With help of the same tool, we have successfully fabricated planar nanogap electrodes of predetermined spacing using direct high-resolution metal nanotransfer printing (nTP) on a solid substrate. Our recent progress in developing imprint processes for directly patterning organic semiconducting polymers such as poly(3-hexylthiophene) (P3HT) is also shown.