Abstract: The growing demand for flexible and cost-effective printable optoelectronic devices can be fulfilled employing organic semiconductors, comprising either polymers or low molecular weight organic molecules with π-conjugated electron system. This thesis is focused on the experimental study of photophysical and charge-transport properties of these materials, in particular phenomena related to a transient state after photoexcitation or charge transfer, with the aim to understand the underlying processes important for their functionality in various devices in organic electronics, particularly in field effect transistors (OFETs) and memristors, and to optimize their performance. We also demonstrate the potential of exciton management in organic semiconductors that can be exploited in organic photovoltaics.

Using transient optical absorption spectroscopy, we show that thiophene-diketopyrrolopyrrole (TDPP) derivatives exhibit structure-dependent excited state evolution leading to an effective generation of triplets, possibly through singlet fission, and the impact of thermal effects in pump-probe laser spectroscopy measurements on obtained data. Additionally, we found that TDPP-based polymer mixed with perylene, or polymethacryalamide with carbazole side groups are capable of exhibiting electronic memory and synapse-mimicking functionalities. Furthermore, the impact of mobile electric dipoles present in polymer dielectrics on hysteresis in current-voltage characteristics of OFETs has been elucidated, with the possibility to control these effects by crosslinking or surface passivation.

Keywords: Organic semiconductors, π-conjugated molecules, exciton management, charge transport, OFET, memristor