

Controlled crystallization for trap free charge carrier transport in organic semiconductors

Organic electronics, commonly known as plastic electronics, is increasingly considered as a new direction of electronic industry that in the coming years can successfully cooperate with traditional silicon technology. The extraordinary progress in the synthesis of novel organic materials has resulted in the intensive development of this field, which allows us to consciously design new compounds for their specific applications. However, before organic electronics can be widely employed, further optimization of fabrication procedures and device architectures based on organic semiconductors is needed.

The conditions in which the active semiconductor is deposited and its self-organizing properties affect the quality of the produced thin films and then their ability to transport charges carriers, which defines the operating parameters of opto-electronic devices.

In the frame of submitted proposal and international cooperation, we would like to prove that by controlling the conditions of the semiconductor layer deposition process, we are able to control the quality of the layers, and thus the electrical parameters of fabricated devices. The most important point of the conducted research is the use of theoretical simulations to describe the phenomena that occur in the process and its correlation with experimental data. Thanks to this approach, it will be possible to understand the process of ordering molecules in the active layer depending on their chemical structure, the type of substrate and the deposition parameters. Using the acquired knowledge, the optimal processing window for each type of semiconductor (taking into account the difference in molecular organization induced by chemical structure) will be defined, which will ensure the high quality of the produced layers, which will then be responsible for high-efficiency field-effect transistors.

The final stage of the project will be the fabrication of demonstrator consisting two connected transistors in one electronic circuit showing the application possibilities of the obtained results.