Organic - plasmonic hybrid systems for optoelectronic applications

Abstract:

Over the last decade, the field of plasmonics has been gaining more and more attention in view of opportunities for controlling light-matter interaction on the nanoscale. The integration of active surface plasmon-based elements in nanophotonic circuits leads to new designs and applications of nanophotonic devices since the resulting plasmonic hybrid systems are able to convert optical signals into plasmonic signals and vice versa.

Recent research demonstrated the existence of a loss channel for energy transfer between organic materials and plasmonic structures. This work is focused on investigating the optical energy transfer in plasmonic hybrid structures, by applying a crystalline organic material as an active surface plasmon polariton (SPP) component. The epitaxial grown organic material in the form of nanowires was roll-on transferred from the growth substrate and placed directly onto metal nano-aggregates, creating a system, which allows us to explore exciton-plasmon coupling.

Exploiting the advantageous photoluminescence properties of organic materials, we investigate coupling principles by fluorescence-lifetime imaging microscopy (FLIM), supported by leakage radiation spectroscopy (LRS). We complement our experimental findings on the excitation of “hybrid modes” in plasmonic-metal systems theoretical considerations, carried out by the means of finite-difference-time-domain (FDTD) simulations. Our results lead to a better understanding and controlling of hybrid-mode systems, which are crucial elements in future designs of low-loss energy transfer devices.

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