Abstract

The possibility of adapting plasmonic components in optoelectronic devices has received an increasing amount of attention, mainly due to their high potential for compact circuitries development. To ensure smooth integration of plasmonic solutions into the photonic application, it is required to develop active components, which can convert optical signals into plasmonic signals and vice versa. Extensive studies during the last decades suggested that organic materials could be used as both active and passive nanophotonic elements due to their specific morphology and tunable optical properties. Their ability to be easily transferred to various structures gives additional control over surface plasmon polariton (SPP) excitation, which makes them great candidates for light–plasmon couplers in plasmonic devices. This promise enforces for a continuous search of new materials, structures and device configurations.

The growth of *para*-hexaphenylene nanofibers directly on metallic surfaces opens the new possibility of integrating organic materials into organic-plasmonic hybrid systems. Presented studies showed that changes in temperatures and nominal material thicknesses caused significant modifications in the morphology of organic nanofibers (ONFs) grown on different substrates: muscovite mica, gold, silver and platinum thin films. The substrate strongly affects the size and types of formed polymorphs. In case of platinum, obtained ONFs exhibit extraordinary dimensions with height up to 2μm. The presence of additional two polymorphs revealed possibility to adjust the shape of the material to the system requirements. For effective control of such plasmonic devices, it demands configurations, where SPPs can be locally excited in a well-defined part of a plasmonic circuit.

To investigate the possible exciton-plasmon coupling, the field-enhancing substrates were fabricated using electron beam lithography technique. The experimental and numerical studies were performed to find the optimal size and shape of silver nanostructures. The optical response of the fabricated array of nanosquares was characterised by a two-photon luminescence in combinations with dark-field spectroscopy. Finally, ONFs were transferred on silver nanostructures and characterised by time-resolved photoluminescence spectroscopy. Significant deviations of the photoluminescence lifetime measured for different nanofibers proclaim diverse luminescence loss channels, including excitation surface plasmons as one of them. Additional experiment based on angle-resolved leakage radiation spectroscopy, confirmed possibility of excitation of SPPs via excited ONFs. Furthermore, systematic studies on fluorescence lifetime of *p*-6P nanofibers in the system, supported assumptions of the exciton-plasmon interaction. In order to reduce the uncertainty in the exciton-plasmon studies via photoluminescence lifetime measurements, a dedicated system ("*contact mode"*) was successfully designed and tested. All obtained results confirmed a high potential of *ONFs* as localised sources of surface plasmons in optoelectronic devices