Generation and preservation of field enhancement for organic-plasmonic devices

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This Ph.D. thesis is a study of metallic periodic nanostructures, capable to enhance electric field near metal surface under illumination with near-infrared light. The field enhancement is partially related to plasmonic waves that are coupled oscillations of electromagnetic field and surface charge density in metal, resulting in confined wave on the metal/dielectric interface. Free charges in metal (conducting electrons) behave as free charges in plasma, therefore such discipline is called plasmonics. The utilization of these nanostructures is limited due to plastic deformations and softness of metal, therefore they have been covered with hard protective diamond-like carbon coatings and tested mechanically. There are many techniques in order to observe field enhancement and excitation of plasmonic waves. In this thesis the recently developed polymer ablation technique has been implemented in order to map field enhancement on a polymer-coated metal structures. It has been accompanied by numerical simulations. In order to observe the influence of field enhancement to a nonlinear material, the organic nanofibers have been transferred on top of metal nanostructures. These hybrid photonic-plasmonic systems have been investigated by means of laser scanning microscopy, where the sample surface has been scanned point-by-point and the signal has been collected by a spectrometer or a sensitive detector (photomultiplier tube). Additionally, the dispersion curves for surface plasmon polaritons, excited on metal/organic material interface, have been calculated numerically. Finally, a real application of such hybrid structures has been presented in form of fabricated organic phototransistor, which is believed to demonstrate enhanced performance of device.