Topic PhD QT: Impact of plasmonic nanoparticles on the exciton management in polymer nanocomposites.

Školitel: RNDr. Jiří Pfleger, CSc. (ÚMCH – Ústav makromolekulární chemie AV ČR, Oddělení Polymery pro optoelektronické a energetické aplikace)
Školitel specialista: prof. Ing. Ivan Richter, Dr. (KFE FJFI ČVUT v Praze)

Abstrakt: The possibility of sub-wavelength manipulation of the optical field using localized surface plasmon (LSP) phenomena occurring at noble metal nanoparticles (NPs) has been recently attractive, among others, for the design of various optoelectronic devices for photoelectrical energy conversion. The LSP phenomena are proposed as a mechanism for enhanced efficiency in photovoltaics (PV) and light sources. However, it is very difficult to unequivocally identify the nature of such enhancement, since various competing phenomena occur due to the presence of metal NPs in the device. These often lead to deterioration of the device performance due to effects such as exciton quenching at the metal surface or LSP resonance absorption, which leads to rapid energy dissipation. The aim of the project is to study the impact of various plasmonic nanostructures on the exciton dynamics in organic semiconductors, including their generation, dissociation, recombination and transport. The work will combine experimental and theoretical approach and consists of theoretical modelling and optimization, preparation of nanostructures combining organic materials and metallic plasmonic nanostructures, and study of exciton dynamics using ultrashort transient optical absorption spectroscopy and other time-resolved optical methods. In particular, the plasmon-exciton interactions in the plasmonic nanostructures will be studied, in view of nanoscale strategies for light harvesting. The research will be targeted towards development of new paradigms of improvement of efficiency of organic solar cells, light-emitting diodes and sensors.

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