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Optical functionality of plasmon-exciton nanomaterials in the strong coupling regime

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Understanding optical plasmon-exciton interaction in hybrid plasmonic nanostructures is important for tuning the optical response, e.g. for applications in nonlinear optics, organic solar cells, or organic light-emitting diodes. In developing such nanostructures, the strong coupling phenomena play crucial role allowing to efficiently transfer energy between plasmons and molecular excitons on a femtosecond time scale. In this talk I will discuss modeling aspects of various optical phenomena at plasmonic interfaces using Maxwell-Bloch equations in three dimensions. Various plasmonic systems including periodic V-grooves, bowtie antennas, nanowires, periodic hole arrays, and others will be considered. In particular, I will demonstrate that one can design hybrid nanomaterials with highly pronounced Fano resonances using femtosecond lasers. I will show that it is possible to use ultra-short laser pulses to materials with desired properties and functionality. Electromagnetic energy transport in systems composed of closely spaced nanowires in a presence of molecular excitons will also be discussed.