FLUORESCENCE LIFETIME IMAGING MICROSCOPY ENHANCEMENT UTILISING HYBRID PLASMON-EXCITON MODES IN STRONG-COUPLING REGIME

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Fluorescence lifetime imaging microscopy (FLIM) plays a significant role in biomedical research that can reveal the conditions of intracellular environment, protein-protein interactions, and even mechanical forces acting on the cells to name a few. While the main advantage of FLIM is that temporal properties of fluorescent decay are independent of intensity, large number of photons may be necessary to recover complex decay information. This is an issue as some cells lines of interest can only express a small amount of fluorescent protein before the cell behaviour is significantly affected, and imaging them for extended periods of time may lead to photodamage. Other cell lines may exhibit dynamic changes and require rapid acquisition, which limits the amount of detectable photons. The project will utilise plasmonic structures to improve the performance of Fluorescence Lifetime Imaging (FLIM) by increasing the signal-to-noise ratio and reducing sample photobleaching. This is possible due to hybrid plasmon-exciton interactions which occur in the molecules of fluorophores and reduce photobleaching. This is important because photobleaching directly affects fluorescence intensity and lifetime, and hence FLIM measurements. Strong-coupling between plasmonic nanostructures and fluorophore's excitons allows for significant reduction and control of photobleaching by tuning the strength of the interaction between plasmon and exciton. During strong-coupling the energy transfer between plasmon and exciton occurs faster (via coherence time) than energy losses can occur, and hence significantly lower the probability photobleaching.