# Excitonically and Plasmonically Powered Processes: From Design to Devices

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**Abstract:**

The presentation will summarize our recent efforts to understand some of the fundamental processes in plasmonic as well as excitonic systems with emphasis on the translating of these knowledge to devices. Precise assembly of plasmonic materials of desired size and shape allows modulation of their optical and field effects, opening up several plasmonically powered processes such as hot electron injection and surface enhanced spectroscopy. We have recently demonstrated that plasmonic effects are significantly high when the gap between nanoparticles is less than 15 nm and the Raman signal enhancement factors at the hot spots follow a distance (d) dependence of $1/d^n$ with n=1.5. These studies provided fundamental insight on plasmon coupling and surface enhanced spectroscopy. By adopting these principles, we have designed platforms having arrays of well-organized plasmonic structures with precise nanogaps, which can generate multiple hot spots. These plasmonic platforms were further used for the identification of molecules of importance in health, environment and safety with an enhancement factor in the order of $10^{10}$. These aspects will be discussed in the first part of the talk.

The second part of the presentation will illustrate our efforts to remodel the surface ligands on semiconductor quantum dots and its consequence on electron transfer process. By modifying the surface ligands on QDs, we could generate stable radicals of methyl viologen (paraquat) at ambient conditions by preventing back electron transfer from CdSe quantum dots. Paraquat is widely used as herbicide owing to its high efficiency even though banned in many countries due to its extreme toxicity. The high solubility of paraquat in water results in its downstream movement by rain, which affects the whole ecosystem adversely by contaminating the water sources. The biological activity of paraquat originates from its high reductive nature (reduction potential of -0.45 V vs NHE) which blocks electron transport processes in the living systems. Direct SERS detection of these radicals at ambient conditions using plasmonic platforms will be presented.

**References and Notes:**

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