**Tailoring light-matter interaction in exciton-plasmon system composed of 2D transition metal dichalcogenide semiconductors and plasmonic nanostructures**

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**Plasmonic nanoresonators can transfer energy efficiently from incident light to sub-wavelength regions via exciting surface plasmon resonances. Localized surface plasmon resonance (LSPR), collective charge oscillation in plasmonic metal nanostructures, can produce strong plasmonic near-fields around them and the optical properties of the emitter near plasmonic nanostructures can be significantly manipulated. Two dimensional (2D) Transition Metal Dichalcogenide (TMDC) monolayer semiconductors integrated with such plasmonic cavities are able to form a unique exciton-plasmon coupled system which can significantly modify the optical properties of 2D TMDC monolayers, depending on the design of the plasmonic nanoresonators. Both weak (Purcell) and strong (Rabi) coupling regime can be achieved in accordance with the coupling strength between exciton and plasmon. MoS2 monolayer integrated with mode-tunable plasmonic nanoantennas were demonstrated to be a unique 2D exciton-plasmon system with spectrally tunable, large PL enhancements (50× via Purcell effect, *weak exciton-plasmon coupling*) as well as surface enhanced Raman scattering (SERS) at room temperature. By reducing the damping of the MoS2 excitons at low temperature, *strong-coupling* between these systems was achieved for the first time and manifested as *Fano* resonance, an asymmetric lineshape due to quantum interference between a narrow discrete resonance (2D excitons) and a broad continuum of states (plasmons). Furthermore, Rabi splitting, a direct evidence of strong coupling regime, was demonstrated in exciton-plasmon system by angle-resolved reflectance measurement which exhibits the optical dispersion of the systems. These exciton-plasmon systems can be used to create novel devices and opto-electronic applications via tailoring electronic functionality and light-matter interaction for flexible and wearable devices.**