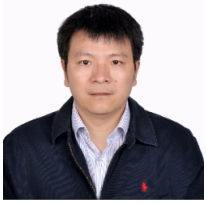
Light Science & Applications

Coupling between two-dimensional excitons with plasmonic nanocavities

School of Physics, Peking University, China

Xiulai Xu
Email: xlxu@pku.edu.cn

Plasmonic nanocavity with mode volume beyond the diffraction limit can greatly enhance the interaction of light and matter. At the same time, two-dimensional excitons in transition-metal dichalcogenides layers have attracted wide attention because of the large exciton binding energy, highly efficient single photon emission from defects and so on. It is of great significance to realize the interaction of such cavity and excitons and reduce the number of excitons involved in coupling to the level of few excitons or even single exciton for solid state cavity quantum electrodynamics. In order to realize exciton-polaritons formed by two-dimensional excitons and plasmonic nanocavity at a low exciton number, we fabricated a compact bowtie nanocavity and successfully realized a strong coupling of MoS_2 excitons and bowtie nanocavity with high robustness. The number of excitons involved in the coupling is reduced to about 40-48, which is the lowest for this type of work so far. Subsequently, in order to realize the interaction between excitons and nanocavity at the level of single exciton, we investigated the coupling of single localized defect excitons in a two-dimensional layer with chiral plasmonic nanocavity. By designing a chiral plasmon mode with high quality factor and coupling it with a WSe_2 monolayer, we achieved cavity-dependent photon output from a single quantum emitter. The solution of the dynamics model of this coupled system shows that the chiral photon output mainly comes from the spontaneous emission of the quantum emitter which is strongly modified by the chiral plasmonic nanocavity. This proves that the valley-dependent optical selection rules are absent in such quantum emitters.



Short Bio:

Xiulai Xu received his PhD degree in Optics from University of Cambridge, United Kingdom. He is currently a Boya distinguished professor of School of Physics, Peking University, China. He is focusing on quantum optoelectronics with low dimensional semiconductors.