In-situ tunable open (non-monolithic) cavity as a powerful platform for research on 2D-material based single photon emitters

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Single photon emitters play a vital role for quantum applications such as quantum infomation processing, communication and sensing. During past decades, a broad attention has been payed to solid state quantum emitters due to their compatibility with current state semiconductor technology. In consequence, novel and low-cost class of materials – 2D crystals – has recently emerged as a promising candidate for quantum applications. In particular, the interest has been strongly attached to mono- and bi- layers of transition metal dichalcogenides (TMD) due to natural emergence of defects in their crystal lattice hosting single emitters that are bright and of high single photon purity [1]. Besides, these sources can be tuned via elastic strain engineering [2] and are easily integrated with some photonic structures, particularly with in-plane cavity structures [3]. However, the performance of currently available TMD single photon sources is not quite yet matched with the state-of-the-art [4].

In this work, we investigate a TMD-monolayer-based single photon source. We integrate a WSe_2 monolayer into an open access cavity to enhance the emission of a single exciton localized in one of the defects in the monolayer. The cavity features 2 freely movable mirrors and is placed into a liquid-helium free cryostat possessing great stability. The tunability nature of the cavity provides us with real-time light-matter coupling manipulation, emission-cavity matching and emitter radiative rate modification. This, along with the stamp'&'play essence of TMD, permits for easy construction of, excessive benchmarking and limits testing of TMD-based single photon sources. Thus it proves itself as an important precursor step toward scalable TMD-cavity based single photon sources. We show that it is possible to engineer an open cavity based single photon source exhibiting near-to-state-of-the-art brightness, high single photon purity accessed through second-order correlation function value < 0.1 and evidence of quantum interference accessed with Hong-Ou-Mandel interference experiment [5].

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