Excitation scheme-dependent characterization of quantum emitters from bilayer WSe_2 localized states.

Piccinini, Claudia; Paralikis, Athanasios; Madigawa, Abdulmalik Abdulkadir; Vannucci, Luca; Gregersen, Niels; Munkhbat, Battulga

Publication date:
2024

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):
Piccinini, C., Paralikis, A., Madigawa, A. A., Vannucci, L., Gregersen, N., & Munkhbat, B. (2024). *Excitation scheme-dependent characterization of quantum emitters from bilayer WSe_2 localized states.*. Abstract from 12th International Conference on Quantum Dots, Munich, Bavaria, Germany.

Excitation scheme-dependent characterization of quantum emitters from bilayer WSe_2 localized states

Claudia Piccinini[1], Athanasios Paralikis[1], ∗ Abdulmalik A. Madigawa[1]
Luca Vannucci[1], Niels Gregersen[1], and Battulga Munkhbat[1]

1- Department of Electrical and Photonics Engineering, Technical University of Denmark, 2800 Kgs. Lyngby, Denmark

clapi@du.dk

Among the other applications is the field of quantum technologies, some layered materials, such as TMDCs and hBN, have been demonstrated to be capable of emitting single photons from localized quantum states. The strong light-matter interaction makes them rather efficient in terms of photon–qubit coupling, and their atomic-scale thickness facilitates a high photon-extraction efficiency. Moreover, their stability and easy implementation in photonic and plasmonic integrated devices make them an ideal platform for optics-based, solid-state implementations of QTs.

WSe_2 is the most studied among the TMDCs as a host for quantum emitters (QE). In particular, the first demonstration and subsequent investigations were conducted on single layered materials. Here we fabricated QEs out of a bilayer two-dimensional WSe_2 via deterministic strain and defect engineering. The fabricated TMD QEs exhibit extremely narrow emission lines around 800 nm with a linewidth of around 0.14 nm. Furthermore, they exhibit very good purity of 0.05 and 0.02 under continuous wave (CW) and pulsed excitation, respectively. The narrow emission spectrum of the emitter reveals phonon side bands and zero phonon lines, which allow us to extract relevant information regarding the phonon density of TMD-based quantum emitters.

The knowledge about phonon density of states helps designing advanced optical excitation schemes that can be employed to improve efficiency and indistinguishability of the emitters by either involving or decoupling the phonons.

Additionally, we also demonstrate the quasi-resonant optical excitation of these emitters, showing that the linewidth almost halves down to 0.08 nm (limited by the resolution of the spectrometer) even though the decay time of the state drastically decreases.

We also studied time-resolved emission resonance to study how much charge noise introduces unwanted fluctuation of the resonance which leads to poor indistinguishability.