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Atomic healing of chalcogen vacancies in monolayer WSe_2

Two-dimensional (2D) transition-metal dichalcogenide (TMDC) semiconductors are the atomically thin platforms for a new type of photonics. Therein, atomic-scale deformations such as point defects and grain boundaries, often generate novel 2D physical properties. For example, single point defects in WSe_2 and WS_2 monolayers (MLs) serve as sources for single-photon emissions or electronic dopants, and mirror twin boundaries in $MoSe_2$ MLs provide topologically protected edge-states. In order to exploit these local physical properties into practical device platforms, such atomic-scale deformations must be deterministically controlled in the 2D host lattices of TMDC MLs. Here, we report a simple process for the healing of chalcogen point vacancies on the synthetic ML WSe_2 by metal-organic selenium passivation. We verified such atomic healing process from substantial reduction of the localized exciton states by low temperature photoluminescence. Our work suggests steps to realize the higher quality photonics with atomic precision.

References

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Figures

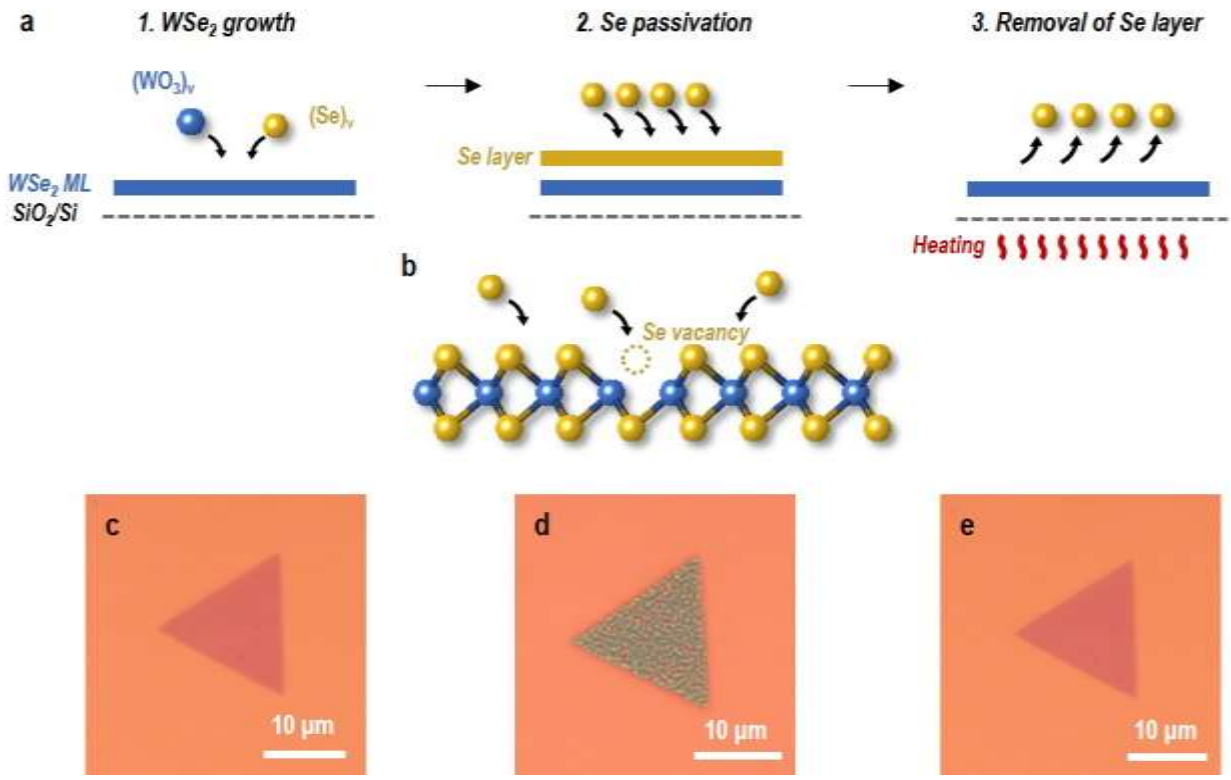

Figure 1: Atomic healing of Se vacancies in CVD-grown monolayer WSe_2 by Se passivation. (a) Schematic for Se passivation process on CVD-grown WSe_2. **(b)** Schematic for Se vacancy healing in the ML WSe_2. **(c-e)** Optical microscope images of **(c)** pristine ML WSe_2, **(d)** Se-passivated WSe_2, and **(e)** Se layer removed WSe_2.