Ordered arrays of quantum emitters from hydrogen-filled TMDC domes

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Abstract

Single-photon emitters (SPEs) have recently attracted a lot of attention from the 2D crystals community [1]. Monolayer-thick hydrogen-filled TMDC domes [2] (Fig. 1a) are presented as a new system for the formation of SPEs. The size and position of the domes is accurately controlled via the application of an H-opaque mask on the bulk crystal, prior to hydrogen irradiation [2]. Notably, capping of the domes with few-layer hexagonal boron nitride (h-BN) is sufficient to prevent their deflation at cryogenic temperatures, due to the condensation of H_2 (Fig.1 b). Second-order autocorrelation measurements confirm the single-photon nature of the domes' photoluminescence (PL) emission that appears at low temperatures (Fig. 1 c). This system provides a new method to create ordered arrays of site-controlled SPEs, without the need for the etching of the substrate, and with the exciting perspective of coupling the quantum emitters with the nano-mechanical resonator represented by the dome's membrane [3,4].

References

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Figures

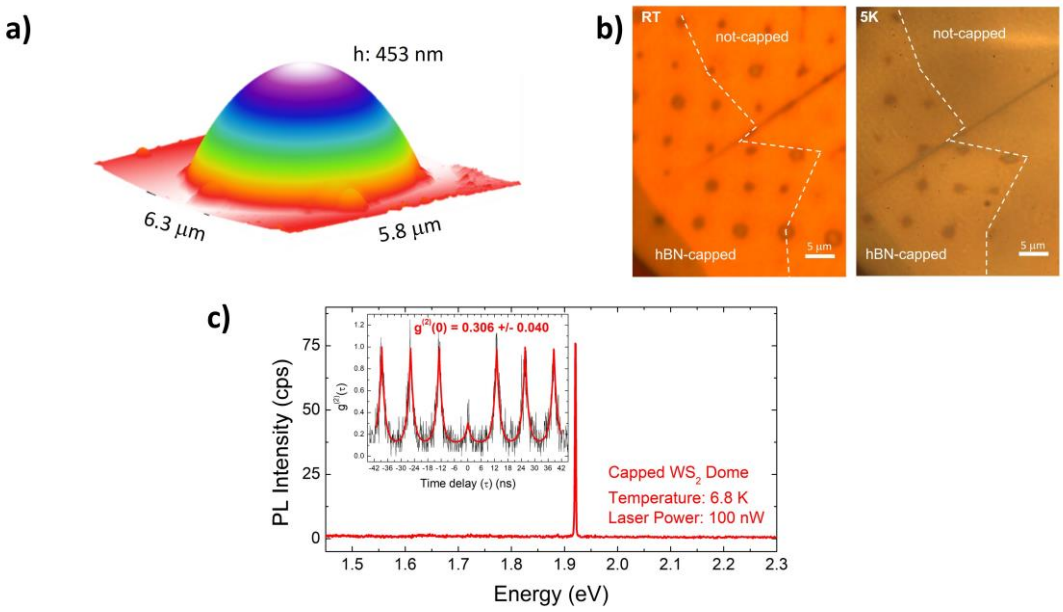

Figure 1: a) AFM image of a hydrogen-filled WS_2 dome, showing its spherical shape. b) Optical images of an ordered array of WS_2 domes capped with h-BN at RT and at 5 K. Only the domes capped with h-BN do not deflate at low temperature. Scalebar, 5 µm. c) PL spectrum at 6.8 K of a WS_2 dome capped with h-BN. The inset shows the second-order autocorrelation function, $g^{(2)}(\tau)$, proving the single-photon nature of the emission.