

# Localized emission in MoSe<sub>2</sub> monolayers on GaN nanopillars

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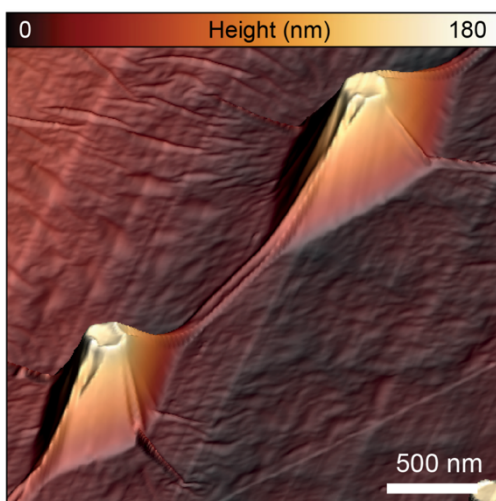
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Solid-state quantum emitters (QEs) in two-dimensional semiconductors offer compact, chip-compatible sources for quantum photonics. In transition-metal dichalcogenides (TMDs), nanopillars are widely used to induce localized emission[1], yet the underlying confinement mechanism and the relative roles of strain versus dielectric environment remain unclear. The general problem addressed here is whether strain alone explains quantum emitter formation and placement in MoSe<sub>2</sub>, or whether dielectric contrast at suspended-supported interfaces is also required. Here, we combine hyperspectral photoluminescence superlocalization with co-registered AFM topography and phase to map the positions of localized states (LS) in MoSe<sub>2</sub> suspended on GaN pillars and correlate them with bending strain and the local dielectric environment. Contrary to the common assumption of purely strain-driven activation, LS frequently occur at suspended--supported interfaces around the pillar apex and span a broad strain range without a clear threshold, while being scarce along high-strain ripples. Our data indicate that deterministic emitter positioning in Mo-based TMDs benefits from co-engineering both strain gradients and nanoscale dielectric heterogeneity, rather than strain alone[2]. More broadly, this combined optical-mechanical characterization approach provides a general framework for mapping structure-property relationships in 2D quantum materials at the single-emitter level.

## References

- [1] Lamrani-Alaoui et al. Localized emission in MoSe<sub>2</sub> monolayers on GaN nanopillars. arxiv 2601.15852 (2026)
- [2] Palacios-Berraquero et al. Large-scale quantum-emitter arrays in atomically thin semiconductors. Nature Communications. (1), 15093, (2017)

## Figures



**Figure 1:** AFM image of MoSe<sub>2</sub> suspended on GaN nanopillars. Co-registered strain mapping and hyperspectral PL superlocalization show that localized states cluster near the pillar apex, at the suspended--supported interface, while remaining scarce in other high-strain regions, suggesting that strain alone may not be sufficient and that dielectric contrast could also contribute to emitter localization.