# CVD-Grown Semiconducting Monolayers with Near-homogeneous Excitonic Linewidths

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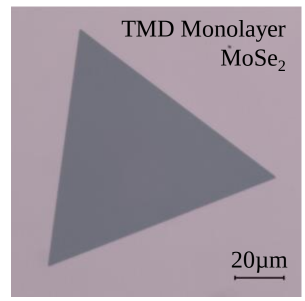
Due to their remarkable features, monolayers of two-dimensional transition-metal dichalcogenides (TMDs) have emerged as an outstanding material platform for exciton physics, correlated phenomena, and a wide field of potential applications in semiconductor and photonic technology. Conventional approaches to the isolation of single layers typically rely on mechanical exfoliation, with limited sample yields and complexity often restricted by the small lateral dimensions of exfoliated crystals. Alternatively, direct growth of extended single-crystal monolayers by chemical vapor deposition (CVD) provides single-crystal sizes of up to several hundreds of squared micrometers, abundance in monolayer crystal number, and potential for scalability and integration. However, it is believed that CVD synthesis is associated with a large defect density, compromising electronic and optical quality of TMD monolayers. In our studies, we used the spectral linewidth of the fundamental exciton transition in CVD-grown monolayers with post-growth encapsulation in hexagonal boron nitride to benchmark the optical quality, and report linewidths in cryogenic absorption and photoluminescence approaching the homogeneous limit. We conclude that our growth yields remarkably high crystal quality to support monolayer exciton physics and correlated phenomena in heterobilayer systems assembled from CVD-monolayers.



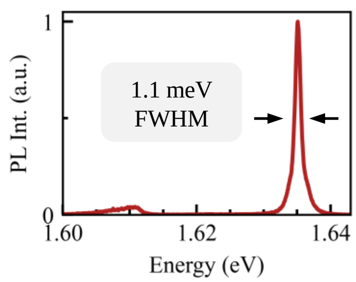




Fig. 1. CVD-grown $MoSe_2$. Top: Optical image of monolayer crystal as-grown on $SiO_2$ substrate. Bottom: Photoluminescence spectrum after encapsulation in hBN at cryogenic temperatures (T=4K).

References

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