Luminescence evolution during growth of monolayer MoS_2: insights into growth dynamics and defectivity

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Semiconducting 2D TMDs such as MoS_2 and WS_2 have direct bandgaps when thinned down to a single layer, enabling strong luminescence which is of interest for opto-electronic and photonic applications.[1] While the photoluminescence of these materials has been extensively studied on large flakes and continuous films, it can also serve as a probe for the microstructure and defectivity of the material during growth. In this work we study the evolution of the photoluminescence of monolayer MoS_2 during cyclic growth by atomic layer deposition (ALD). By correlating this data to extensive further characterization (TEM, XPS, Raman, ellipsometry) and stochastic simulations, we explore the relations between the luminescence spectrum and fundamental parameters of the film such as grain size, coverage and defectivity at different stages during growth.

References

[1] W. Zheng *et al.*, *Adv. Opt. Mater.*, vol. 6, no. 21, p. 1800420, 2018, doi: 10.1002/adom.201800420.

Figures

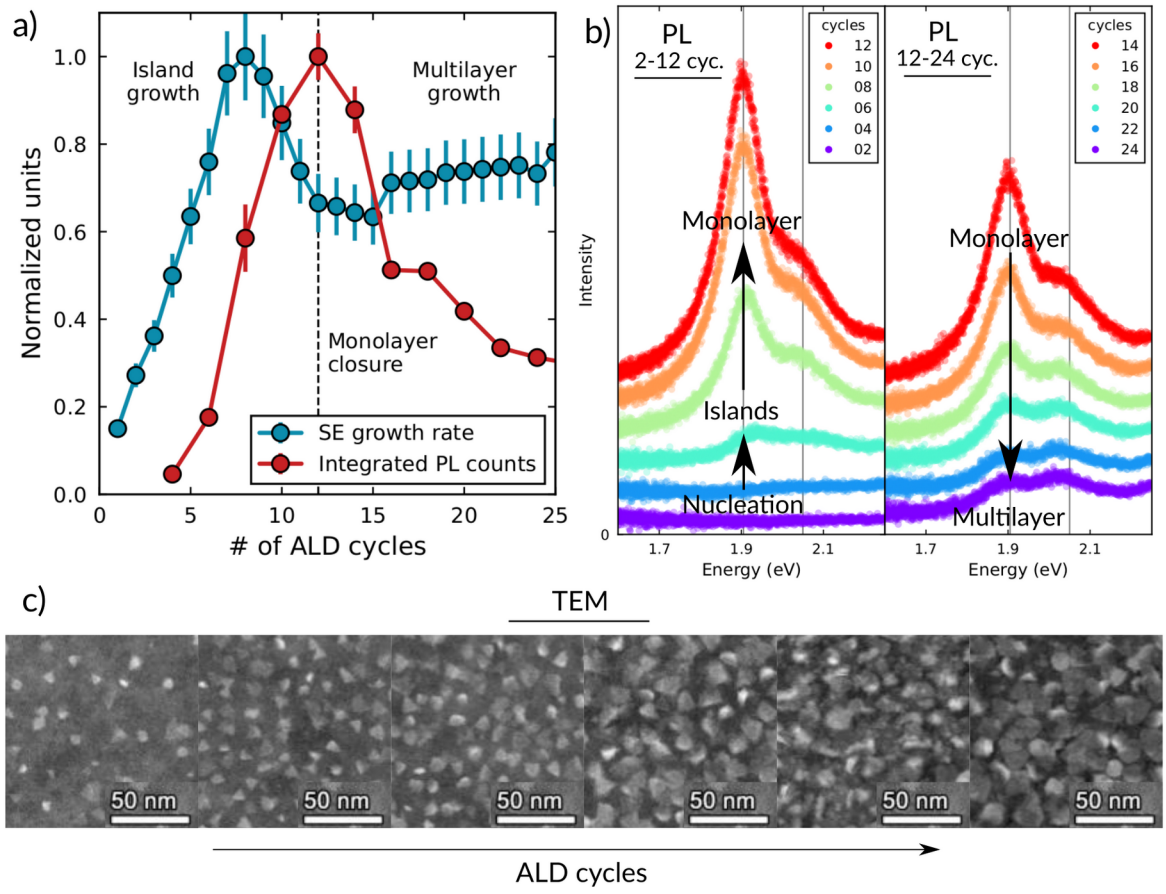

Figure 1: a) Correlation of the growth rate (ellipsometry), and the PL intensity shows the PL optimum at monolayer closure. b) Evolution of the PL spectrum from nucleation to multilayer films. c) Top-view TEM shows the increase in grain size and surface coverage during ALD growth.