Molecular beam epitaxy growth of MoS_2 monolayer on III-IV substrate

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Abstract

Bottom-up synthesis of dichalcogenide-based 2D materials has been developed via several growth techniques such as chemical vapor deposition (CVD), molecular beam epitaxy (MBE), pulsed laser deposition [1, 2, 3]. It turns out that the technique of choice is CVD in which micron-size flakes of monolayers could be achieved in a straightforward manner with a low cost, but it does not allow in general for a homogenous wafer-scale growth and a proper control of contamination. MBE is an alternative growth technique which has been known as a costly and challenging growth technique in terms of defects and small monodomains. However, for the purposes of introducing defect-induced extraordinary properties and large-scale 2D layers for scaling up electronics, optoelectronics and catalysis, MBE still holds a promising position thanks to its versatile regarding substrate selection and low-temperature growth of out-of-equilibrium phases. In the poster, we will show the growth and morphology evolution of MoS_2 on GaN substrate with respect to the growth temperature and time exposure of precursor fluxes. We find that monolayer MoS_2 laterally grows from 2D nucleus on GaN surface over vertical growth, indicating a strong strength of surface energy. This permits to obtain wafer-coverage MoS_2 via coalescence and without starting second layer growth. Interestingly, a sharp angular distribution of monodomains is also observed, pointing to a pellicular feature of the intralayer interaction compared to the interlayer interaction. A comparison with the growth of molybdenum disulphide on graphene substrate will be discussed.

References

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