Microscopic investigations of the growth mechanism of 2D TMD materials via a joint CVD-TEM study

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The precisely controlled growth of two-dimensional materials is now becoming one of the major bottle-necks towards the applications. Therefore, it is crucial to reveal the microscopic growth mechanisms of these 2D materials. In this paper, we choose the 2D transition metal dichalcogenide as a model system, and employ a joint CVD-TEM method where the electron beam transparent membranes, i.e., graphene, boron nitride, ultrathin silicon nitride and silicon oxides are used as the substrate for the CVD growth. In this way, the possible information lost during the sample transfer could be largely avoided. ADF-STEM, HRTEM, XEDS and EELS characterizations enable us to reveal the microscopic processes for the nucleation, edge developments during the CVD growth of 2D TMD materials. Furthermore, the growth mechanics for the substitution of chalcogen elements to form the alloyed 2D TMD materials are also explained.

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