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Uniform wafer-scale growth of stencil templated, high-quality monolayer MoS₂ ETHEL PEREZ-HOYOS, JUSTIN YOUNG , MICHAEL CHILCOTE , Ohio State Univ - Columbus, MATTHEW BARONE , university of virginia , SARA MUELLER , ROLAND KAWAKAMI, EZEKIEL JOHNSTON-HALPERIN, Ohio State Univ - Columbus — With the widespread interest in transition metal dichalcogenides and the recent focus on two-dimensional (2D) vertically stacked heterostructures, a need for an inexpensive and reliable method of producing clean, high-quality, patterned 2D materials has emerged. Here, we report on a templated MoS₂ growth technique by metal sulfurization where Mo is deposited through a SiN stencil onto highly-crystalline sapphire substrates. After sulfurization, the resulting MoS₂ films are shown to be high-quality with thicknesses that can be tuned layer-by-layer—down to a single layer—through manipulation of the initial Mo deposition time. The quality of these films is confirmed through scanning electron and atomic force microscopies as well as Raman and photoluminescence spectroscopy. This facile growth technique results in templated, high-quality MoS₂ films with centimeter-scale uniformity, feature sizes down to 100 nm, and offers both a means to easily probe MoS₂ growth dynamics and a route to 2D stacked heterostructures with arbitrary geometry and pristine interfaces. We will discuss potential applications of this novel growth technique for the development of TMD heterostructures and alloys.

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