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Controlled physical vapor growth of WSe_2 and other MX_2 monolayers PAUL NGUYEN, JOE FINNEY, CHUNMING HUANG, PASQUAL RIVERA, SANFENG WU, Department of Physics, University of Washington, GENEVIEVE CLARK, Department of Material Science, University of Washington, ZAIYAO FEI, XIAODONG XU, DAVID COBDEN, Department of Physics, University of Washington — Although exfoliated monolayers of two-dimensional semiconductors such as WSe_2 show extraordinary and potentially useful optical properties, the ability to grow them in a controlled way will be critical for tuning their properties, incorporating dopants, and making devices on larger scales and with high yield. We are investigating their growth by physical vapor deposition on insulators such as silicon dioxide without catalyst, systematically varying the growth parameters (gas flow and type, sources, temperature, and substrate), with a focus on WSe_2 which has the smallest gap and strongest spin-orbit coupling of the MX_2s. While MoS_2 monolayers of high optical quality can easily be grown as triangular single crystals tens of microns in size using a simple MoS_2 source, WSe_2 proves to be much more sensitive to the growth parameters, as well as to air leaks and contamination of the furnace tube. Nevertheless we have reproducibly grown monolayer WSe_2 crystals up to 15 microns in size showing excellent optical properties using a WSe_2 source and pure hydrogen carrier gas.

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