Growth of Monolayer MoSe2 and WSe2 with the Assistance of Halide Catalysts

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Most modern electronics utilize silicon semiconducting devices, however limitations in silicon are causing performance in computers to plateau, researchers are looking to new materials to replace silicon. 2D materials are one proposed solution. Graphene was the first researched 2D material, however the absence of a band gap limits it from being natively used as a semiconductor. 2D transition metal dichalcogenides (TMDs) are now being researched over graphene in the interest of semiconductors. TMDs exhibit unique properties such as tunable band-gap and atomic thickness desired in semiconductors. Chemical vapor deposition (CVD) is the standard technique used to grow TMDs, however it normally requires expensive specialized high pressure systems and growth times exceeding 20 minutes. This study presents a novel CVD growth method for TMDs, MoSe2 and WSe2, under atmospheric pressure with growth times as short as 4 minutes. This was possible by using halide salts as catalysts to the growth, and optimizing growth temperature and flow rate. Raman spectroscopy and photoluminescence were used to confirm the successful growth of monolayer TMD crystals, which showed no signs of doping or decreased quality due to the halide catalysts. The quicker growth time and elimination of specialized high pressure CVD systems makes this growth method more cost efficient than prior developed methods. Materials like the ones grown in this study improve computing at its base unit, allowing improvements in transistors, solar cells, and touch interfaces, with broad implications in industrial, military and consumer electronics.

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