PdSe2 Single Crystals Synthesized by Flux Method

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PdSe2 possesses a low-symmetry pentagonal, layered structure. With unique atomic arrangement leads to interesting mechanical properties, including unusual negative Poisson's ratio and ultra-high mechanical strength [1]. Furthermore, this low-symmetry structure offers new characteristics for in-plane anisotropy in optics and electronics. For example, $PdSe_2$ possesses a strong linear dichroism ratio, up to 1.9, which can act as a high polarization-sensitive photodetector [2]. Notably, both chemical vapor deposition (CVD) grown and exfoliated PdSe2 exhibit extremely high air quality stability and device performance stability, which provides an excellent opportunity for future large-scale electronic device applications. Palladium diselenide (PdSe2), a noble metal dichalcogenide, has emerged as a new 2D material with widely tunable bandgap for device applications, however the direct synthesis of high-quality PdSe2 is still challenging. Here we demonstrate the growth process of single-crystal $PdSe_2$. The PdSe2 single crystal was synthesized by a self-flux (high-temperature solution) method using Se as a fluxing agent. Selenium with a purity of 99.999% was used as a solvent and a preliminary solid-phase synthesis of the compound $PdSe_2$ was carried, using Pd and Se in stoichiometric amounts as starting materials. To carry out the crystal growth process, the synthesized material was placed in quartz ampoules pumped to a vacuum of 10-5 torr. The growth process was carried out for 4 days at 850°C. Under these conditions, crystals with sizes of 2-3 cm^3 were obtained and crystal quality characterized by XRS, XPS and Raman spectroscopy.

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