

3. Full Area Coverage Monolayer WS₂ on c-cut Sapphire ([Product code: MLWS2FullSapp](#))

This product contains full area coverage WS₂ monolayers on c-cut sapphire substrates. Sample size measures 1cm in size and the entire sample surface contains monolayer thick WS₂ sheet. Synthesized full area coverage monolayer WS₂ is highly luminescent and Raman spectroscopy studies also confirm the monolayer thickness.

Sample Properties.

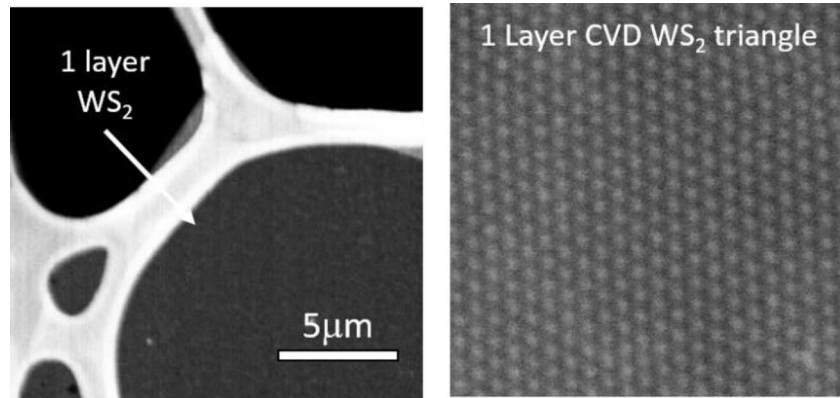
Sample size	1cm x 1cm square shaped
Substrate type	(0001) c-cut sapphire
Coverage	Full coverage monolayer
Electrical properties	2.0 eV Direct Bandgap Semiconductor
Crystal structure	Hexagonal Phase
Unit cell parameters	a = b = 0.312 nm, c = 1.230 nm, $\alpha = \beta = 90^\circ$, $\gamma = 120^\circ$
Production method	Low pressure Chemical Vapor Deposition (LPCVD)
Characterization methods	Raman, photoluminescence, TEM, EDS

Specifications

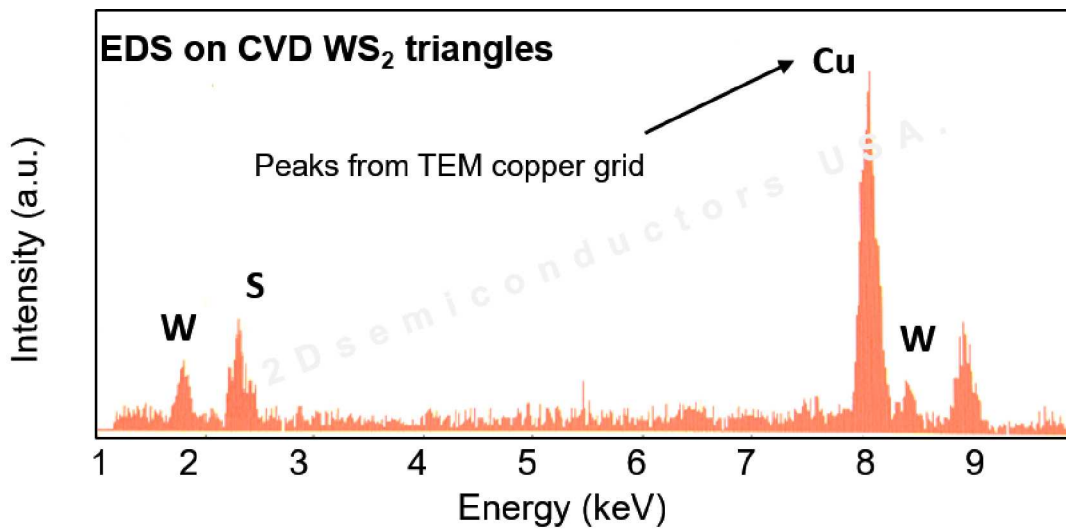
- **Identification.** Full coverage 100% monolayer WS₂ uniformly covered across c-cut sapphire
- **Physical dimensions.** one centimeter in size. Larger sizes up to 2-inch wafer-scale available upon requests.
- **Smoothness.** Atomically smooth surface with roughness < 0.2 nm.
- **Uniformity.** Highly uniform surface morphology. WS₂ monolayers uniformly cover across the sample.
- **Purity.** 99.9995% purity as determined by nano-SIMS measurements
- **Reliability.** Repeatable Raman and photoluminescence response
- **Crystallinity.** High crystalline quality, Raman response, and photoluminescence emission comparable to single crystalline monolayer flakes.
- **Substrate.** c-cut Sapphire but our research and development team can transfer WS₂ monolayers onto variety of substrates including PET, quartz, and SiO₂/Si without significant compromisation of material quality.
- **Support.** 2Dsemiconductors USA is an American owned, regulated, and operated company. Our customers are well-protected by international as well as strict American customer laws and regulations. We give full technical support and guarantee your satisfaction with our well-established customer

Defect profile. WS₂ monolayers do not contain intentional dopants or defects. However, our technical staff can produce defected WS₂ using α -bombardment technique.

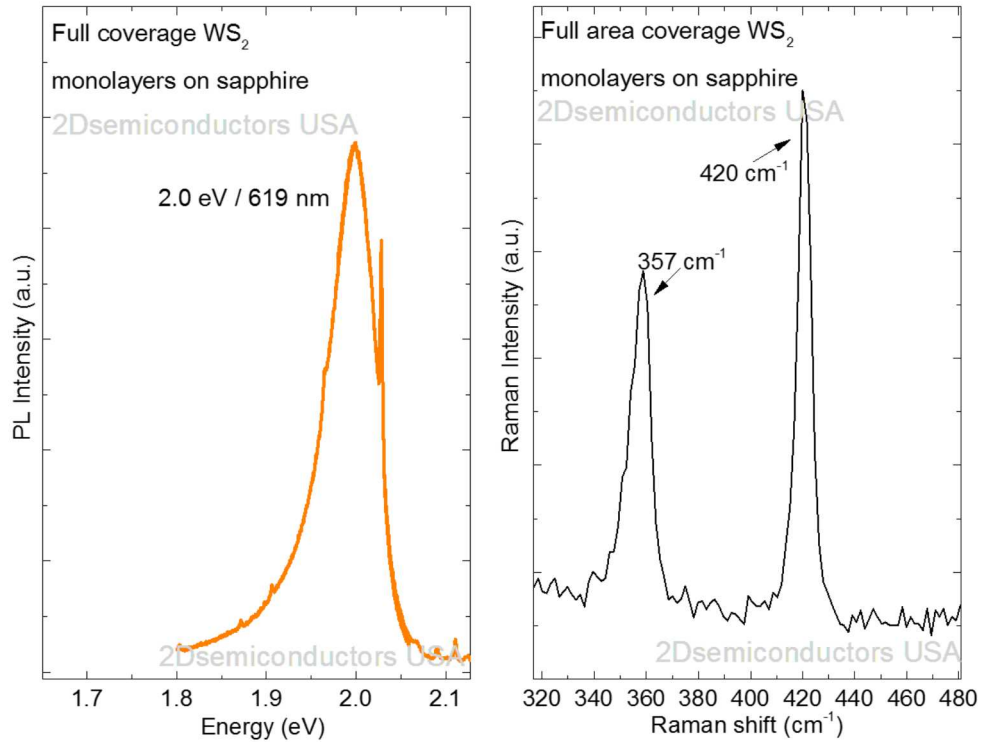
Supporting datasets [for 100% Full area WS₂ coverage on c-cut Sapphire ([Product code: MLWS2FullSapp](#))]



Transmission electron images (TEM) acquired from CVD grown full area coverage WS₂ monolayers on c-cut sapphire confirming highly crystalline nature of monolayers



Energy dispersive X-ray spectroscopy (EDX) characterization on CVD grown full area coverage monolayer WS₂ on c-cut sapphire confirming W:S 1:2 ratios



Room temperature photoluminescence spectroscopy (PL) and Raman spectroscopy (Raman) measurements performed on CVD grown full area coverage WS₂ monolayers on c-cut sapphire. Raman spectroscopy measurement confirm monolayer nature of the CVD grown samples and PL spectrum display sharp and bright PL peak located at 2.00 eV in agreement with the literature.