

ALD-Grown Semimetallic TiS_x for Hole Injection into Monolayer WSe_2

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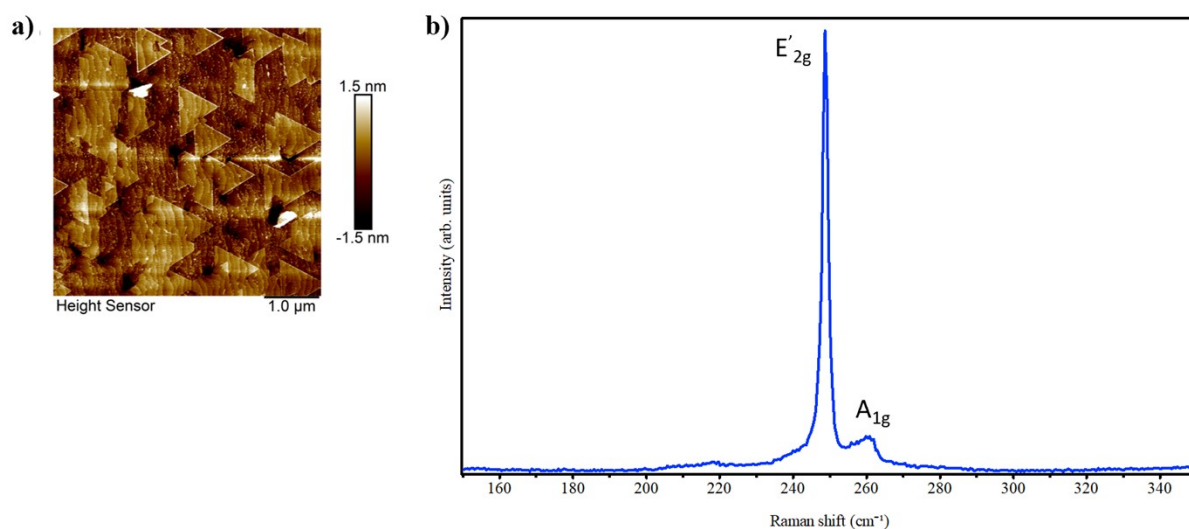


Fig. S-1: AFM image showing a monolayer of WSe_2 with some bilayers (triangular shape) and (b) Raman spectrum of CVD-grown WSe_2 before metallization. Consistent with primarily monolayer WSe_2 , the E'_{2g} peak is near 250 cm^{-1} and the A_{1g} is near 260 cm^{-1} , respectively, without any peak evident from $360\text{--}380\text{ cm}^{-1}$.

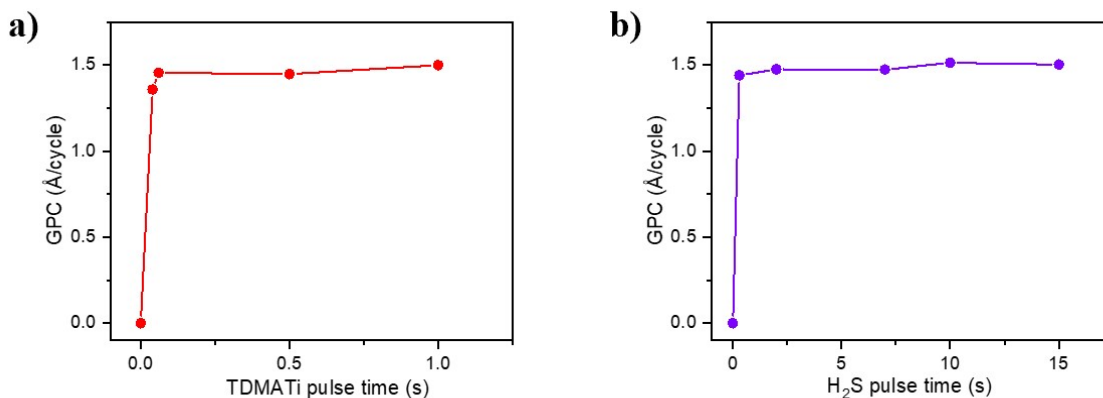


Fig. S-2: Approximate GPC from QCM saturation study for (a) the TDMATi dose with the H₂S held at 10 s and (b) the H₂S dose with the TDMATi dose held at 1 s.

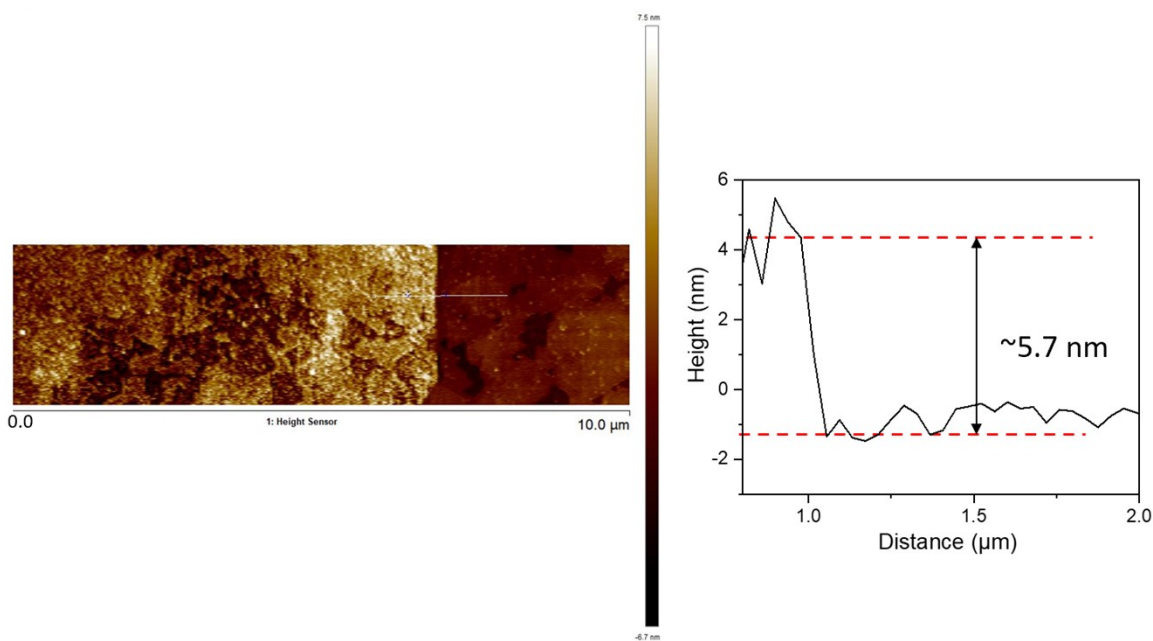


Fig. S-3: Representative AFM image of a step edge. To measure the step height, we used e-beam lithography to create a well-defined edge on the sample, performed 4–7 scans, and calculated the average step height. Some roughness of the TiS_x is observed.

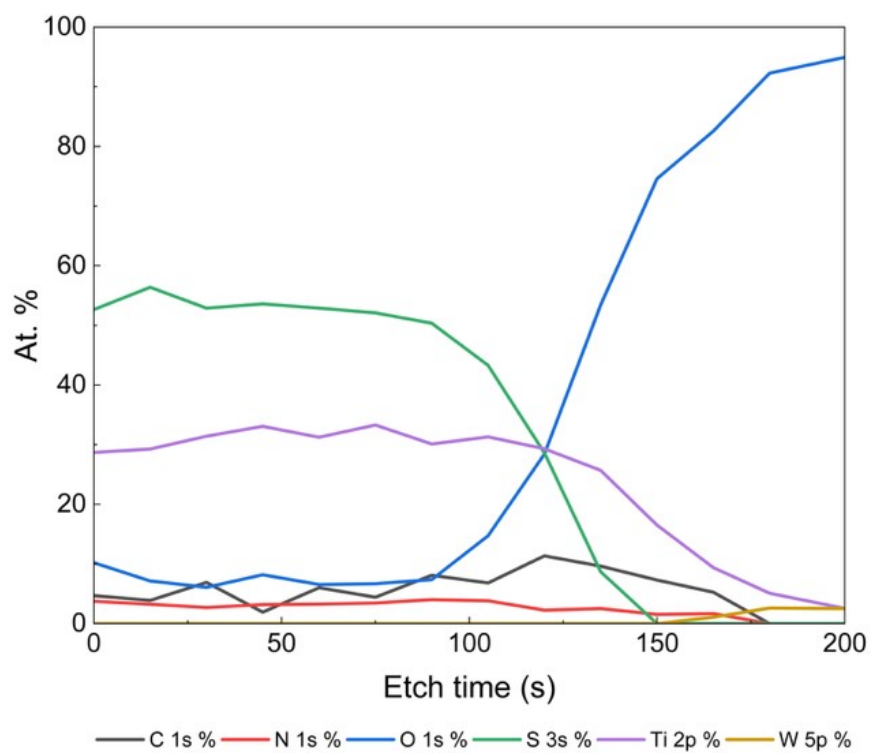


Fig. S-4: XPS depth profile of a TiS_x film deposited on $\text{WSe}_2/\text{Al}_2\text{O}_3$ at 100°C by ALD. Because Al was not included in the profile, the substrate artificially appears to be 100% O.

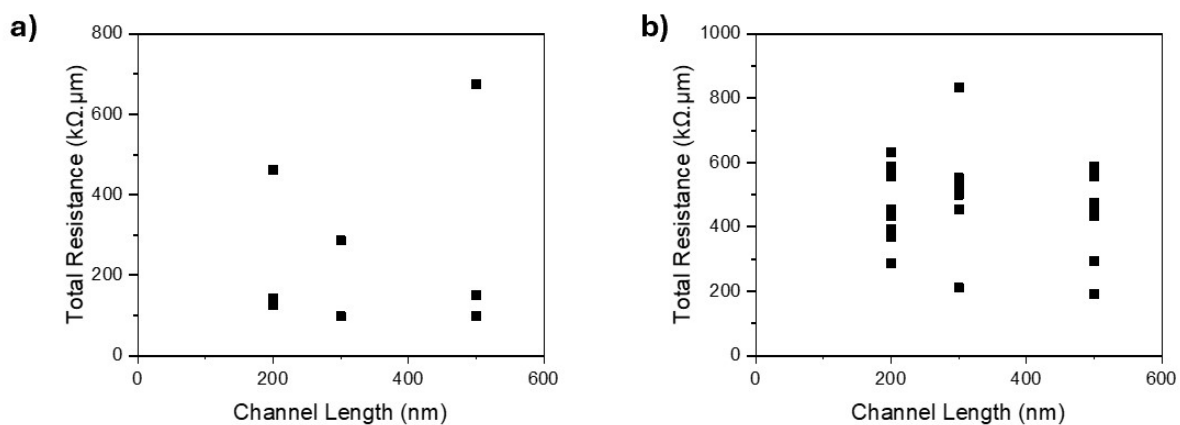


Fig. S-5: Data points from TLM structures (a) 7 nm TiS_x (b) 5 nm TiS_x .

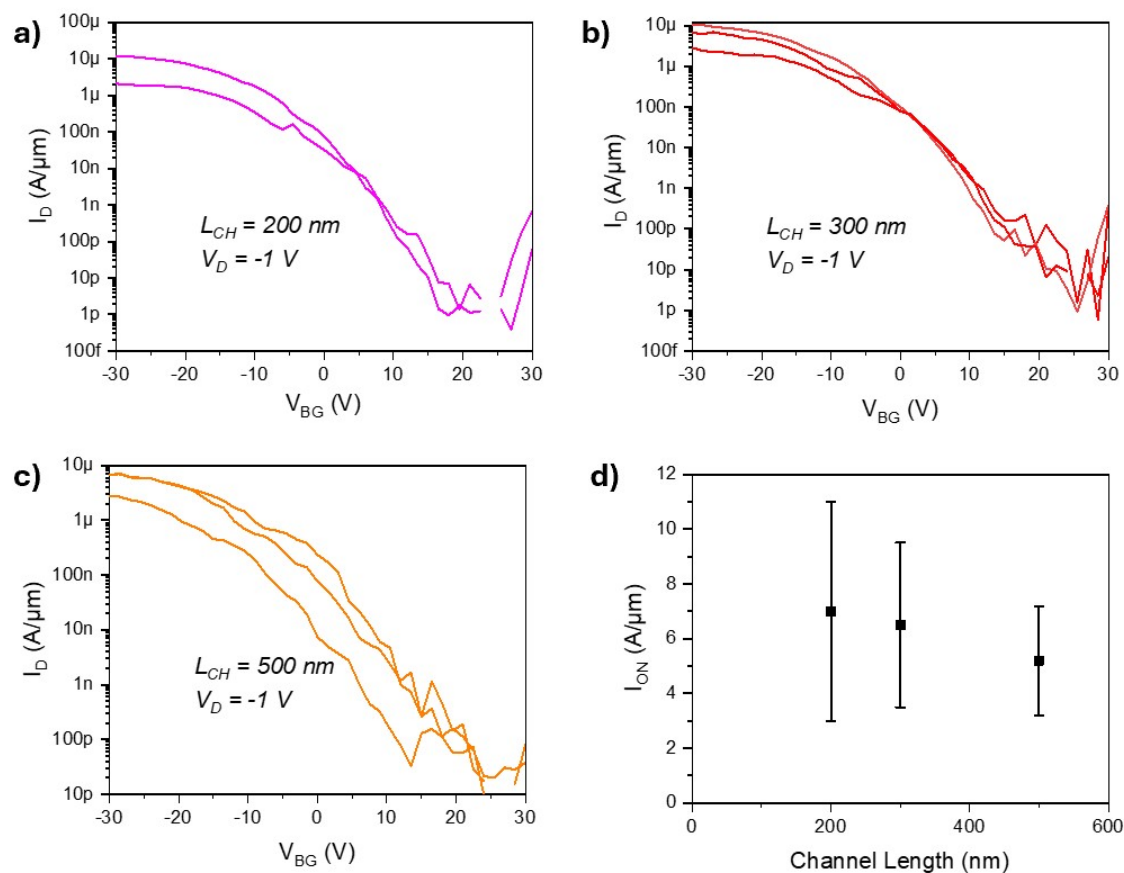


Fig. S-6: 7 nm TiS_x contacts to WSe_2 on Si_3N_4 substrate. Transfer characteristic with different channel lengths of (a) 200 nm, (b) 300nm, and (c) 500 nm. (d) ON current variation for different channel lengths.

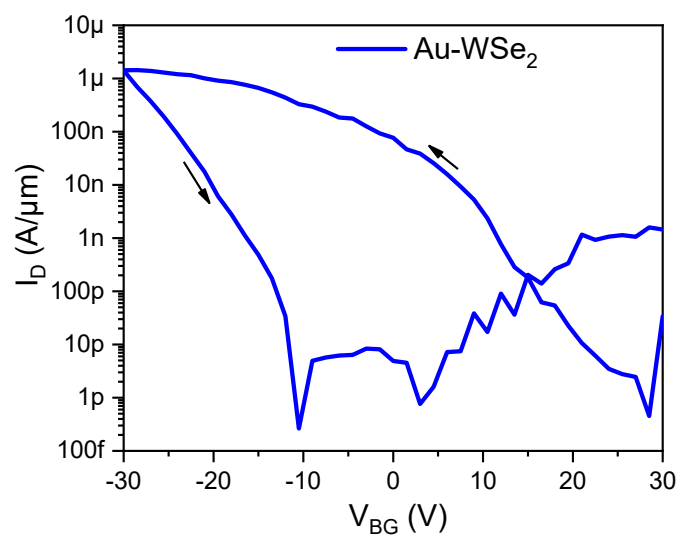


Fig. S-7: Hysteresis in devices with Au contacts for $V_D = -1 \text{ V}$.

Table S-1: Contact configurations and device performance

Contact Configuration	Channel Length	I_{ON} ($\mu\text{A}/\mu\text{m}$)	V_{TH} (V)	SS (V/dec)	μ ($\text{cm}^2/\text{V.s}$)
Au/WSe ₂	200 nm	1.8	-3.0	1.4	0.04
		1.9	-4.7	1.4	0.8
	300 nm	2.0	-2.3	2.1	0.05
		2.0	-1.9	1.6	0.6
	500 nm	1.5	-2.2	1.5	0.4
		2.1	-1.7	1.8	0.14
7 nm TiS _x /WSe ₂	200 nm	5.0	-0.96	1.6	1.40
		8.3	1.5	2.0	0.37
		7.0	0.16	2.3	--
	300 nm	3.7	-0.26	1.2	0.04
		10.6	-3.3	2.0	--
	500 nm	8.0	0.05	1.5	0.95
		11.0	0.37	1.7	0.40
		1.7	-2.3	2.2	0.09