ELECTRONIC SUPPLEMENTARY INFORMATION

Percolative phase transition in few-layered $MoSe_2$ Field-effect transistors using Co and Cr contacts

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Figure S1: AFM Topography and Height profile for Cr-contact and Co-contact $MoSe_2$ FET devices

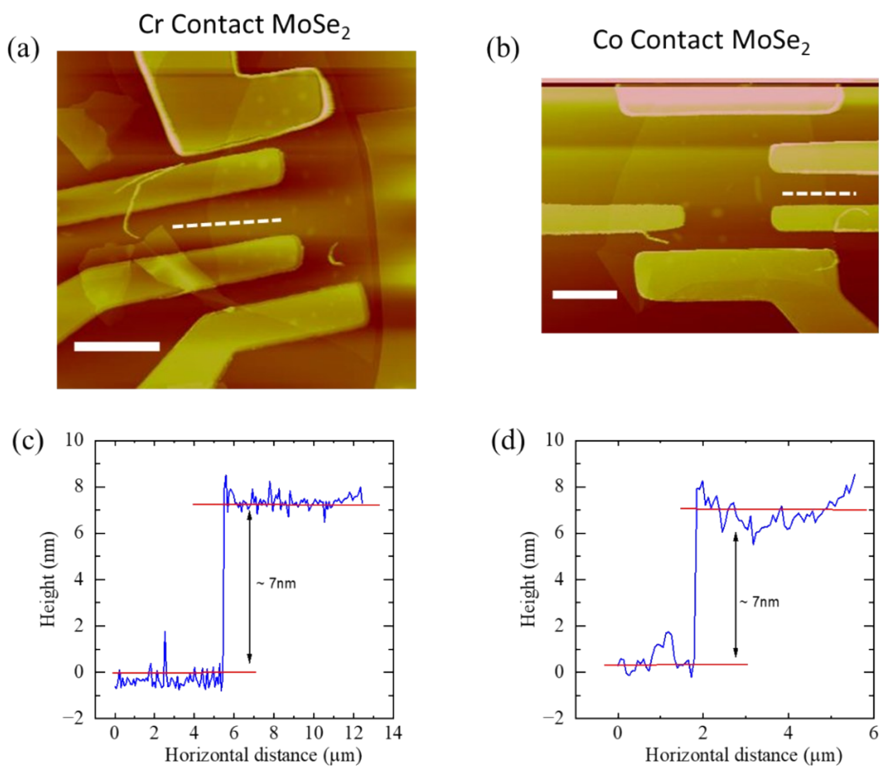

Fig. S1 AFM mapping and height profile: (a) & (b) Height distribution on Cr/Au contact and Co/Au contact $MoSe_2$ device (Scale bar: 5 µm), (c) & (d) Height profile at the lined spot at the corresponding images.

Figure S2: 4-Terminal transport measurements and Contact Resistance

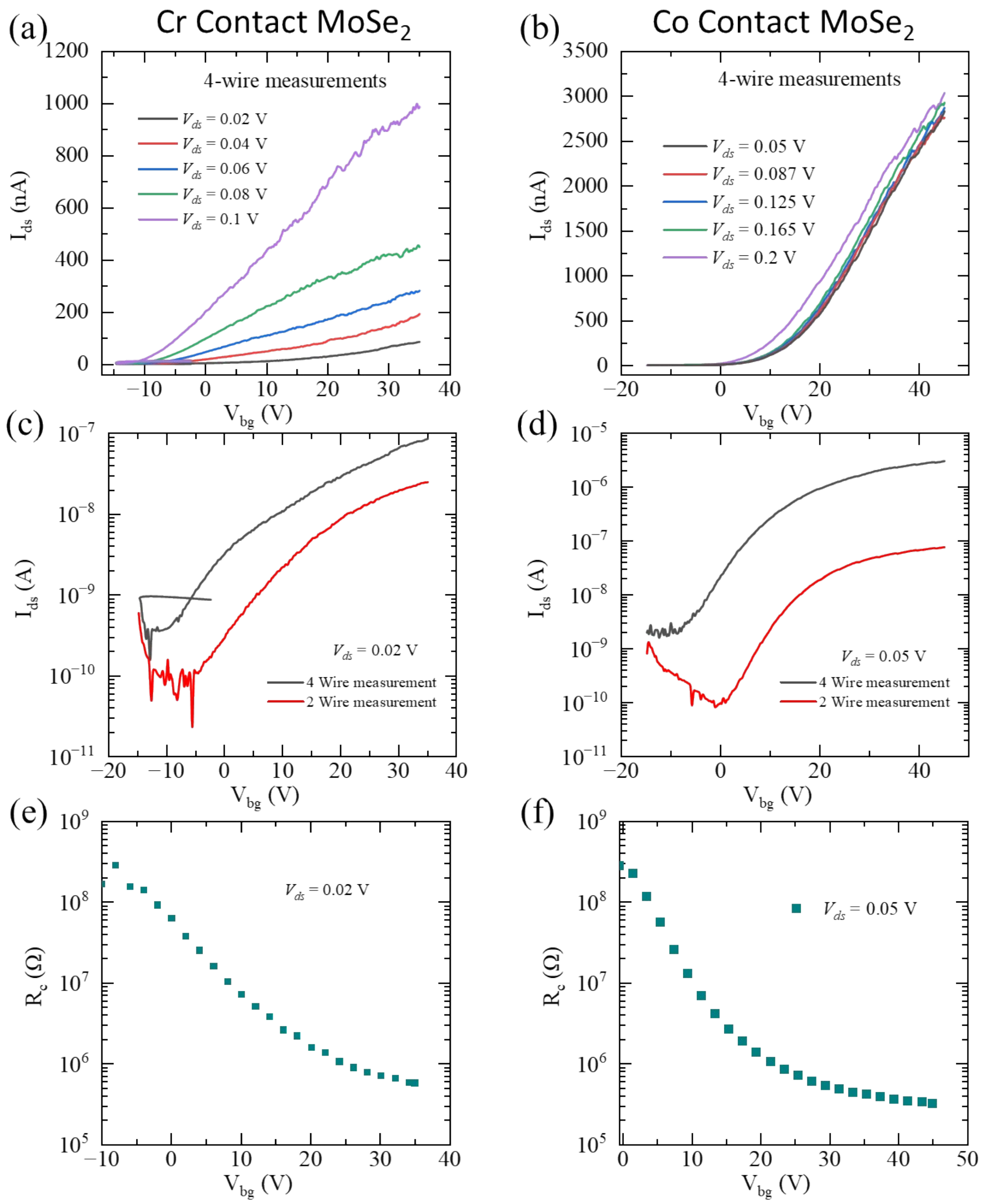

Fig. S2 Basic FET Characterizations with 4-terminal system: (a) & (b) Room-temperature Transfer Characteristics of $MoSe_2$ FET (I_{ds} vs V_{bg}) at different source-drain voltages (V_{ds}) for Cr/Au and Co/Au contact, (c) & (d) comparing 2- terminal measurement and 4- terminal measurement in the drain current (I_{ds}) variation with back gate (V_{bg}) voltage at fixed source-drain voltage (V_{ds}= 0.02V) for both type of devices, (e) & (f) Contact resistance extracted from the difference between 2-terminal and 4-terminal measurement as a function of back gate voltage (V_{bg}) for both contacts.

The details 2-terminal and 4-terminal mobility of the above devices are tabulated below

Device Type	L (μm)	*l* (μm)	W (μm)	μ_{2T} (cm^2/Vs)	μ_{2T} (cm^2/Vs)
Cr-$MoSe_2$	10.2	5.6	8.1	6.5	15.2
Co-$MoSe_2$	12.9	5.7	13.6	16	45.5

Figure S3: Temperature Scaling to the Conductivity Data

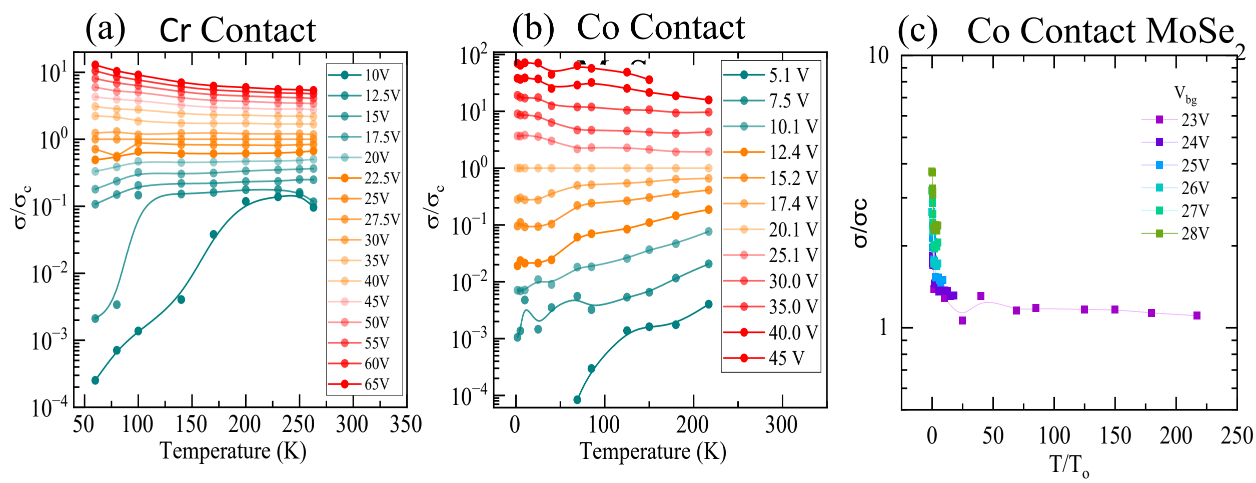

Fig. S3 Temperature scaling with temperature parameter T_o for Co-contact: (a and b) represents the normalized conductivities data at various applied gate voltages. The conductivity data were normalized with the critical conductivity value σ_c showing the metallic branch separated from the insulating branch. (c) shows the scaling of conductivity data with temperature parameter T_o to test whether the conductivities data collapse together according to quantum critical behavior but the data are not near the scaling [Reference 1,2,3] suggested no quantum critical behavior near T=0K.

Figure S4: Percolation fitting for Cr-contact at different temperature

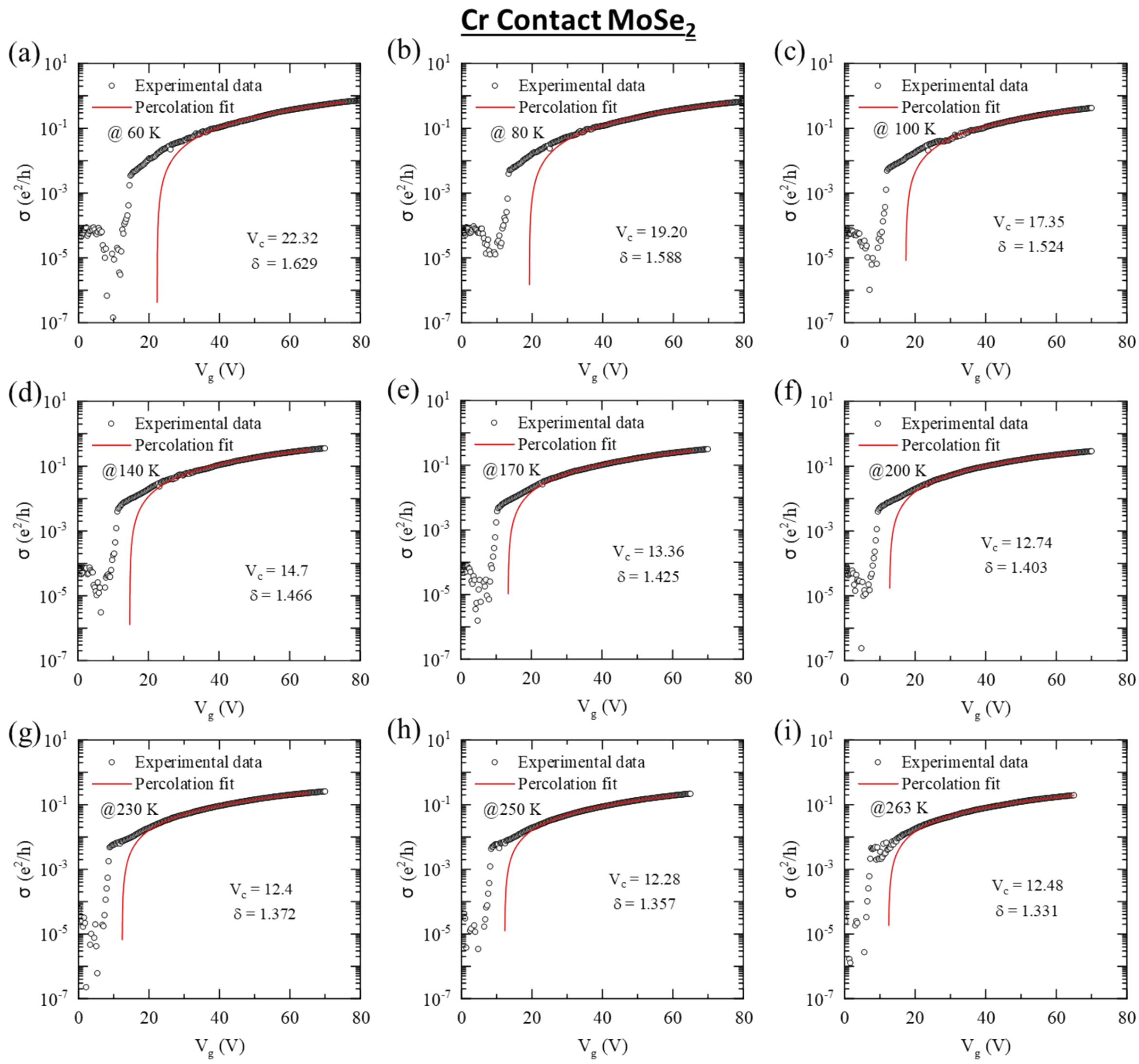

Fig. S4 Percolation Fittings for Cr-contact: (a-i) represents the percolation fitting on the Back gate variation of conductivity at different temperatures varying from 60K to 263K. (Extracted critical voltage (V_c) and critical exponent(δ) for respective temperatures is mentioned)

Figure S5: Percolation fitting for Co-contact at different temperature

Co Contact $MoSe_2$

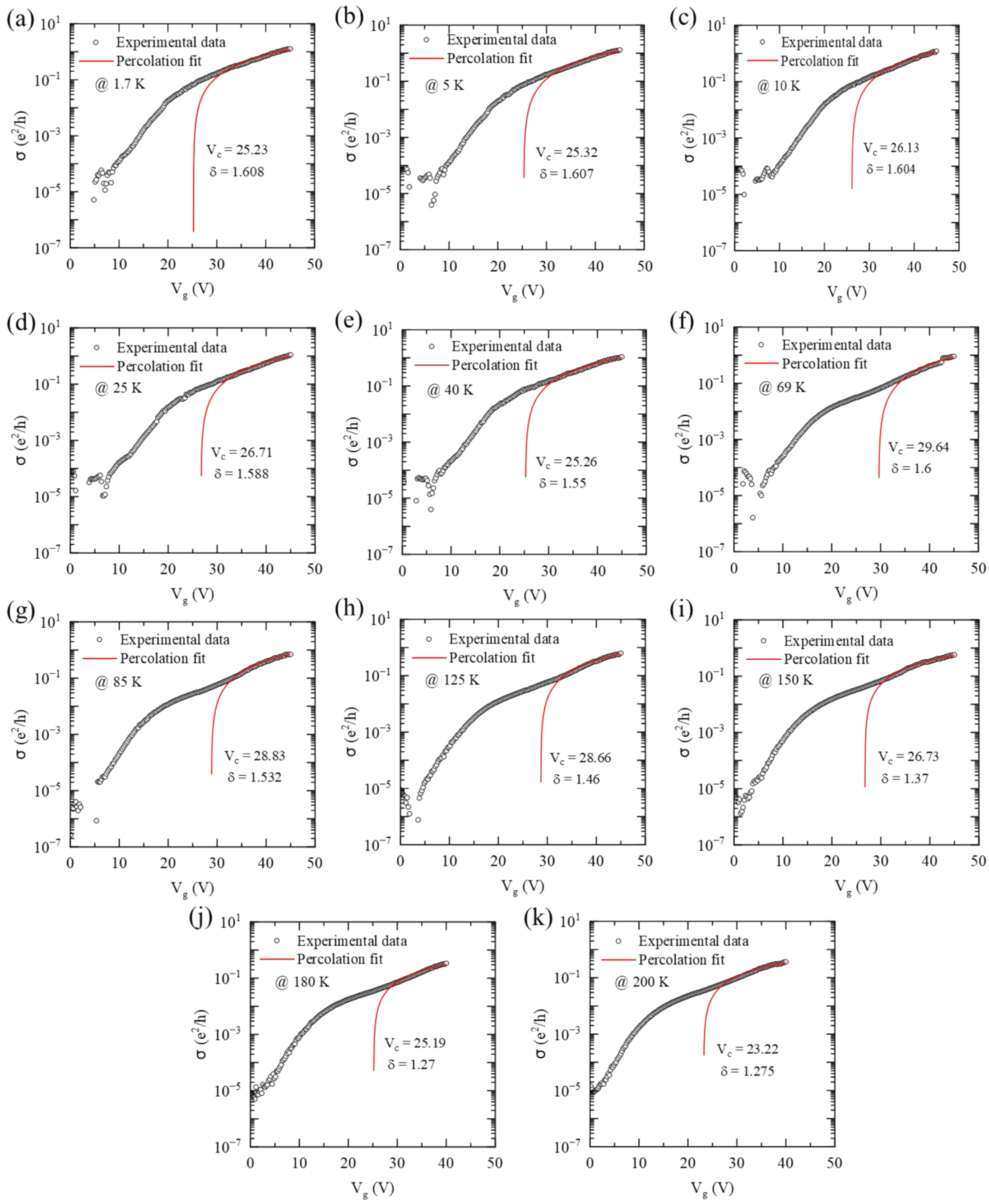

Fig. S5 Percolation Fittings for Co-contact: (a-k) represents the percolation fitting on the Back gate variation of conductivity at different temperatures varying from 1.7K to 200K. (Extracted critical voltage (V_c) and critical exponent (δ) for respective temperatures is mentioned)

References

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2. 32 N. R. Pradhan, A. McCreary, D. Rhodes, Z. Lu, S. Feng, E. Manousakis, D. Smirnov, R. Namburu, M. Dubey, A. R. Hight Walker, H. Terrones, M. Terrones, V. Dobrosavljevic, and L. Balicas, "Metal to Insulator Quantum-Phase Transition in Few-Layered ReS_2," Nano Lett 15(12), 8377–8384 (2015).
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