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Communication

Electrical Properties in Ta_2NiSe_5 Film and van der Waals Heterojunction

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Crystal structure and band diagram

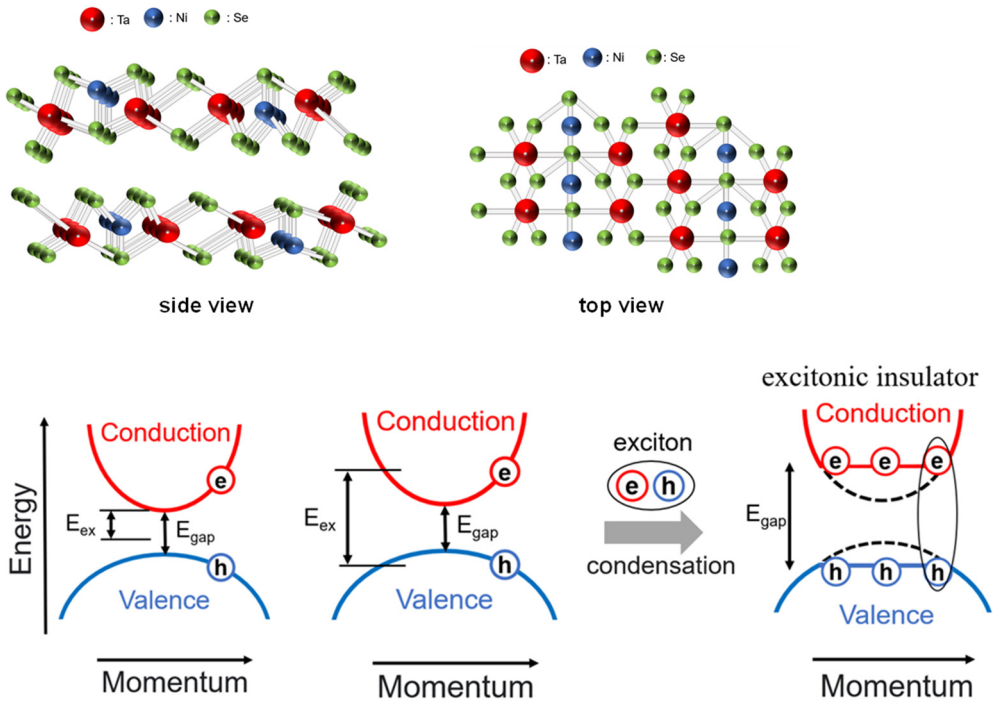
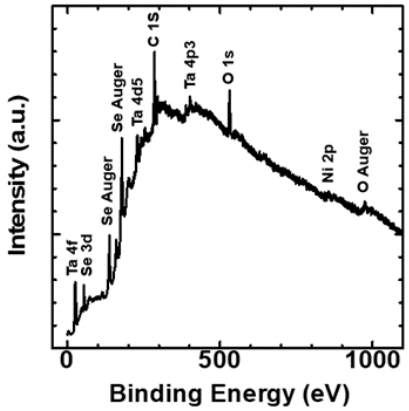


Figure S1. Crystal structure and band diagram of layered Ta_2NiSe_5.

XPS analysis



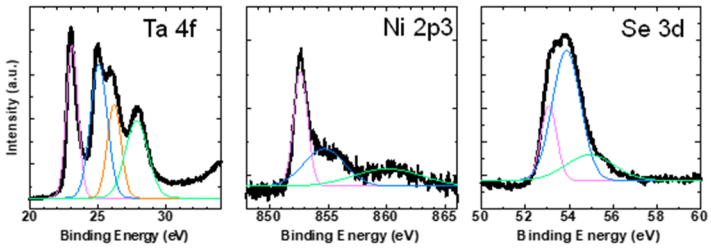


Figure S2. The chemical bond state was characterized by X-ray photoelectron spectroscopy (PHI Quantera IITM, ULVAC-PHI Inc.). Whole XPS spectrum of synthesized Ta_2NiSe_5 flakes. The spectrum was calibrated using the O 1s peak position (531 eV). Ta 4f, Ni 2p and Se 3d core signals of XPS analysis for synthesized Ta_2NiSe_5 flakes are shown.

Back gate device

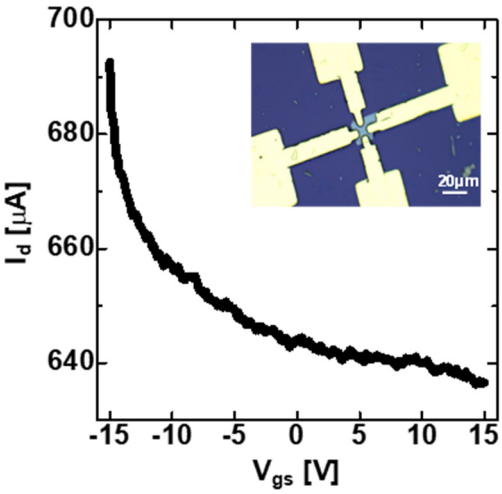


Figure S3. Transfer characteristic of back-gate Ta_2NiSe_5 field-effect device.

Heterojunction and analysis of transport characteristics

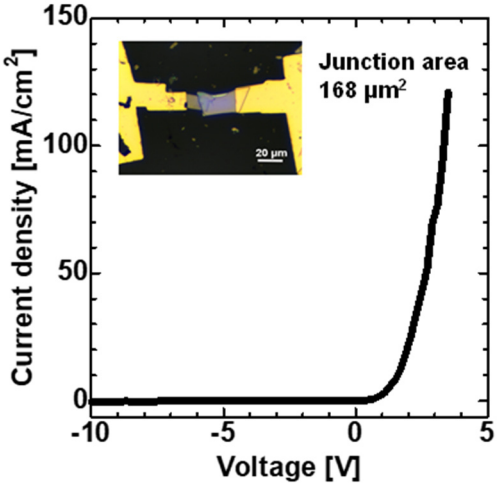


Figure S4. Current density-voltage (J-V) curve of the MoS_2/Ta_2NiSe_5 heterojunction with incomplete interface. The bias voltage was applied to the Ta_2NiSe_5 contact with respect to MoS_2 contact. The interface of incomplete heterojunction includes the van der Waals gap as a thin insulator, leading to the predominant carrier transport by the tunneling mechanism, and a high turn-on voltage.

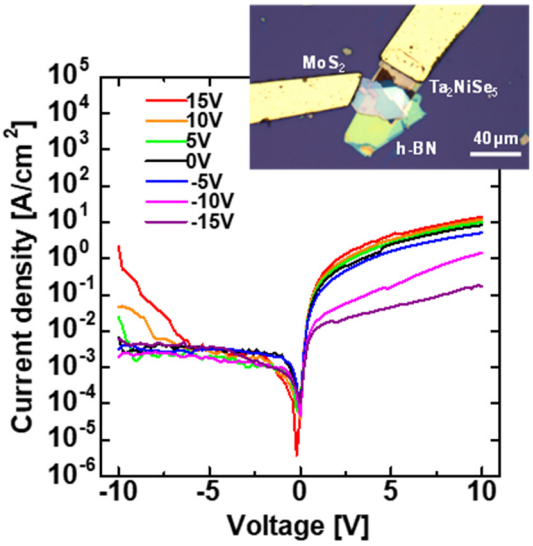


Figure S5. J-V curve of the MoS_2//h-BN/Ta_2NiSe_5 heterojunction with incomplete interface. The maximum on/off ratio was 1610 when the gate bias voltage corresponds to be −5 V.