Supporting Information

Narrow-gap physical vapour deposition synthesis of ultrathin $SnS_{1-x}Se_x$ ($0 \le x \le 1$) Two-dimensional Alloys with unique polarized Raman spectra and high (opto)electronic properties.

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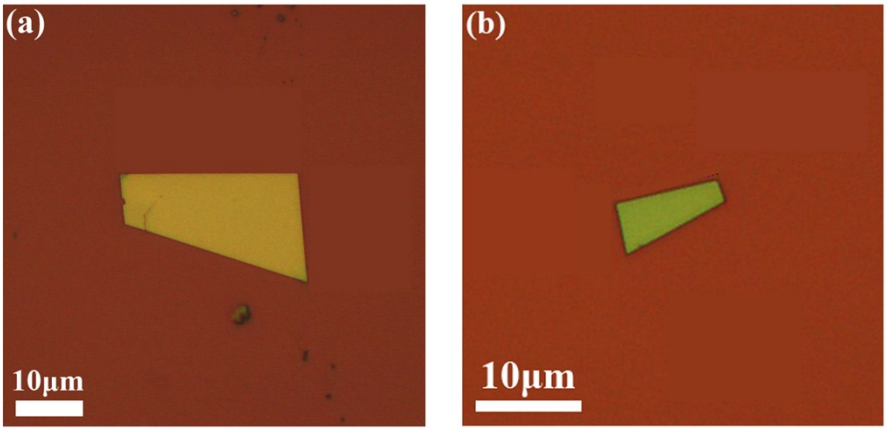

Fig. S1 Optical images of the $SnS_{1-x}Se_x$ alloyed nanosheets by different wafer methods: (a) one wafer method. (b) two wafers covered each other.

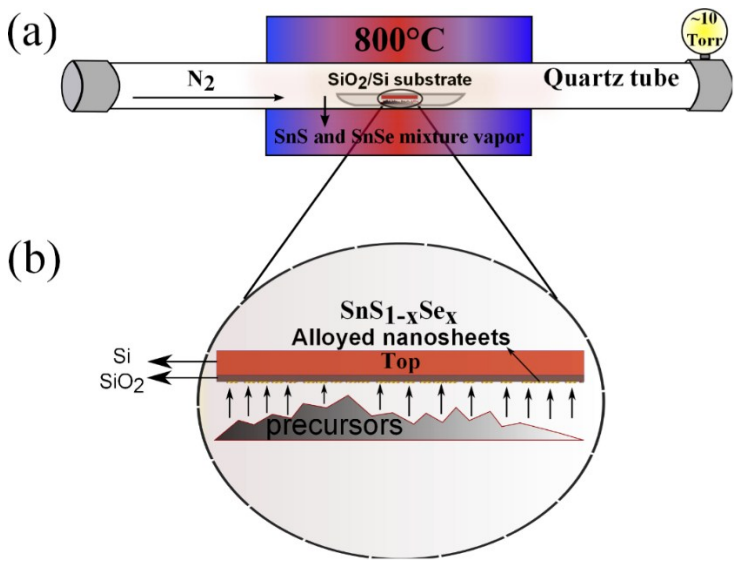

Fig. S2 (a) Schematic diagram for the traditional growth of 2D $SnS_{1-x}Se_x$ alloyed nanosheets. The samples were grown on the top of the SiO_2/Si substrate. (b) Enlarged image of the black ellipse, showing the detailed orientation growth of the alloyed sample.

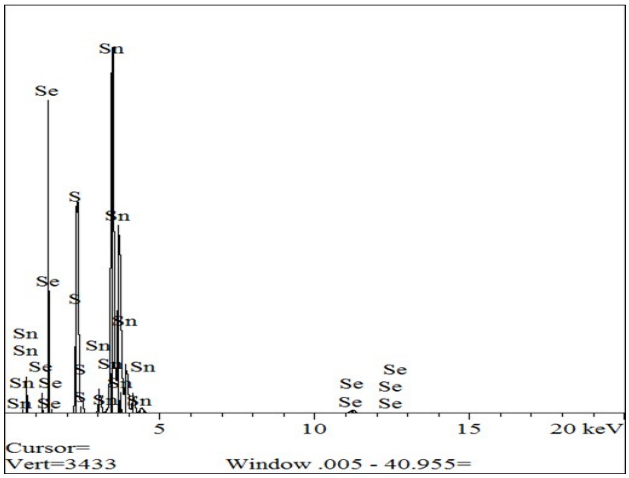

Fig. S3 SEM-EDS of the $SnS_{0.5}Se_{0.5}$ alloyed nanosheets

Table S1. The calculation result extracted from the corresponding EDS spectrum in

Element	Atomic (%)	Theoretical Atomic (%)
S	22.02	20
Se	20.15	20
S/Se ratio	1.09	1

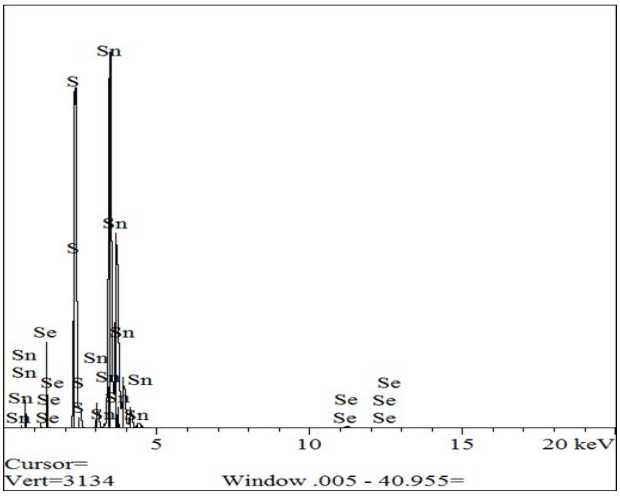

Fig. S4 SEM-EDS of the $SnS_{0.75}Se_{0.25}$ alloyed nanosheets

Table S2. The calculation result extracted from the corresponding EDS spectrum in Figure S3.

Element	Atomic (%)	Theoretical Atomic (%)
S	32.79	30
Se	10.08	10
S/Se ratio	3.25	3

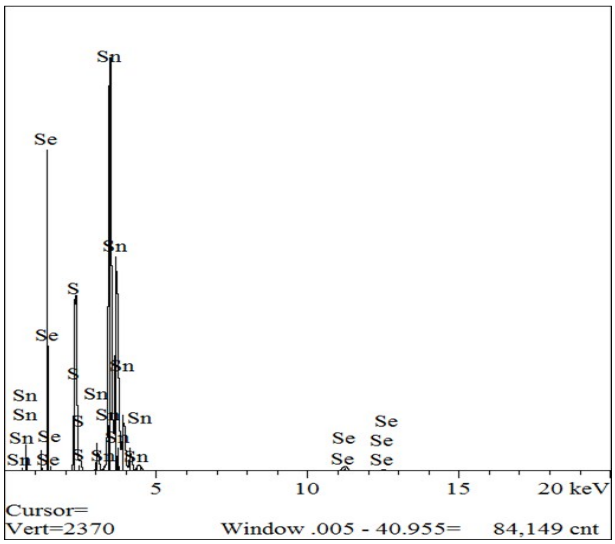

Fig. S5 SEM-EDS of the $SnS_{0.25}Se_{0.75}$ alloyed nanosheets

Table S3. The calculation result extracted from the corresponding EDS spectrum in Figure S4.

Element	Atomic (%)	Theoretical Atomic (%)
S	12.23	10
Se	28.94	30
S/Se ratio	0.42	0.33

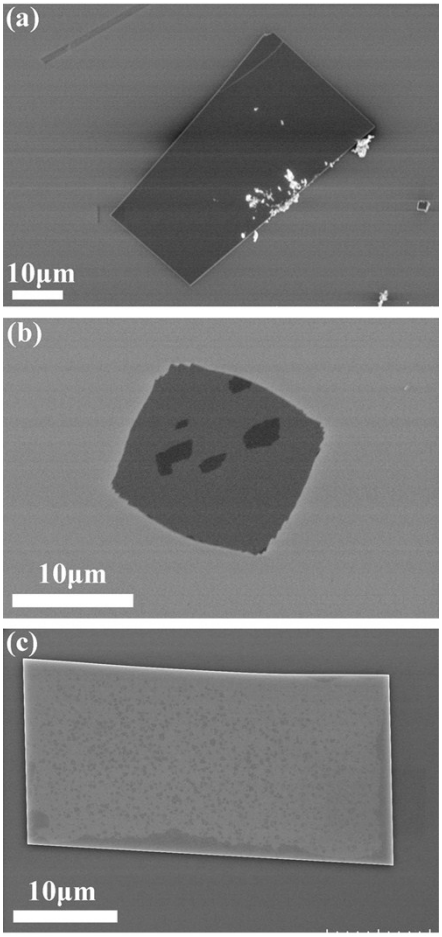

Fig. S6 SEM images of the $SnS_{1-x}Se_x$ alloyed nanosheets via two wafers method (a) Trapezoid. (b) Square. (c) Rectangle.

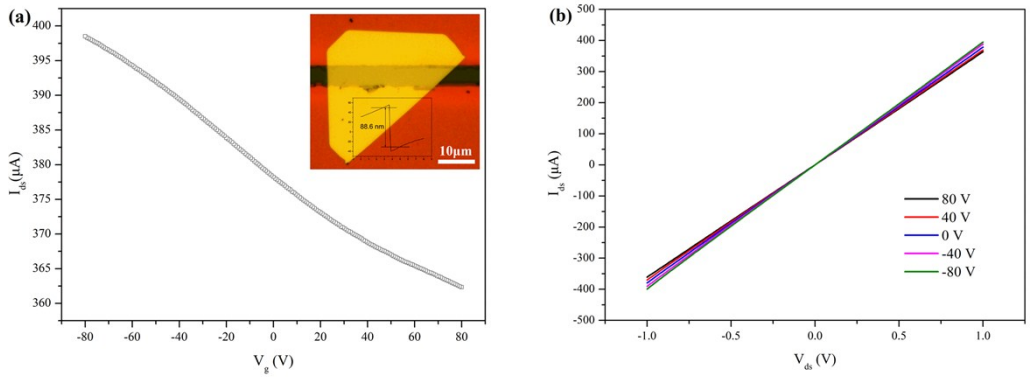

Fig. S7 (a) Transfer characteristic curve of the device under drain voltage of 1 V under dark condition. Inset: the optical image of the device, scale bar: 10 μm. (b) Output characteristic curves of the device under different V_g values (from 80 V to -80 V using step of 40 V).

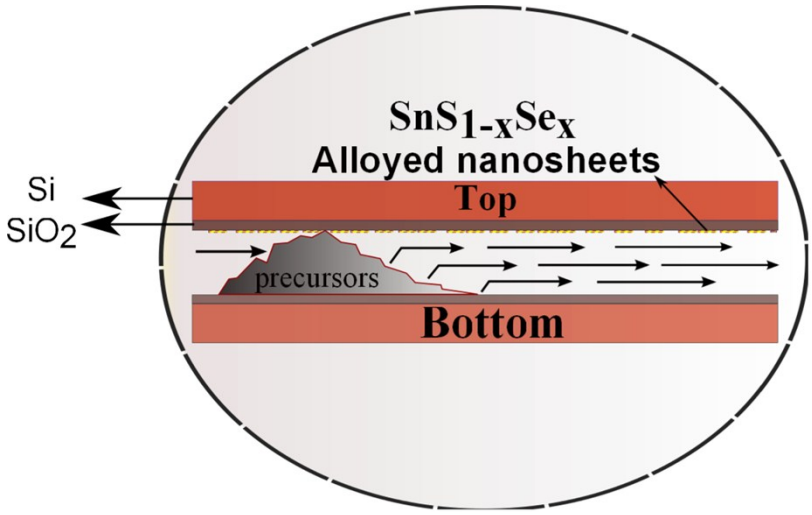

Fig. S8 Macroscopic scheme of NGPVD method, showing the detailed orientation growth of the alloyed sample.

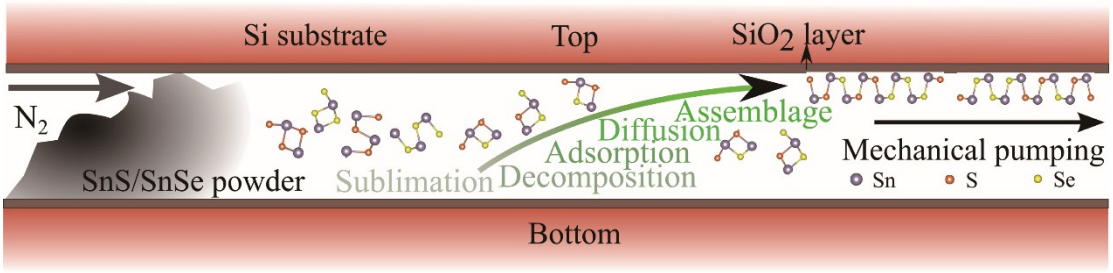

Fig. S9 Microcosmic scheme of NGPVD method, showing the detailed orientation growth of the alloyed sample.

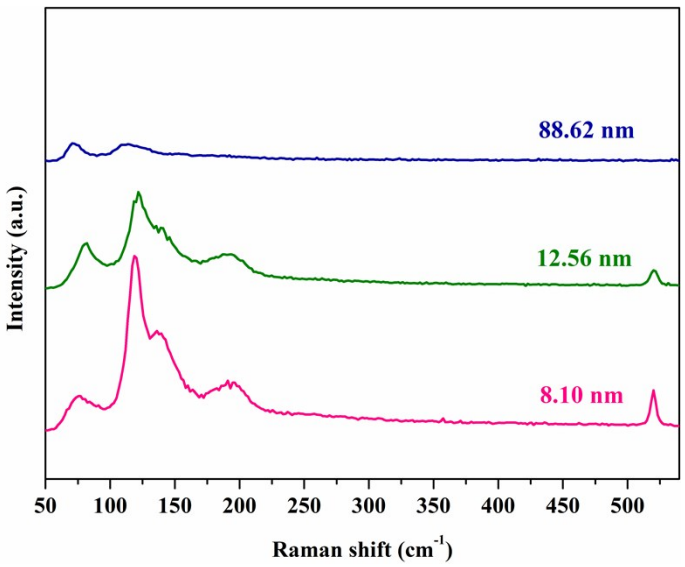

Fig. S10 Normalized Raman spectra of the $SnS_{0.5}Se_{0.5}$ nanosheets with different

thickness.

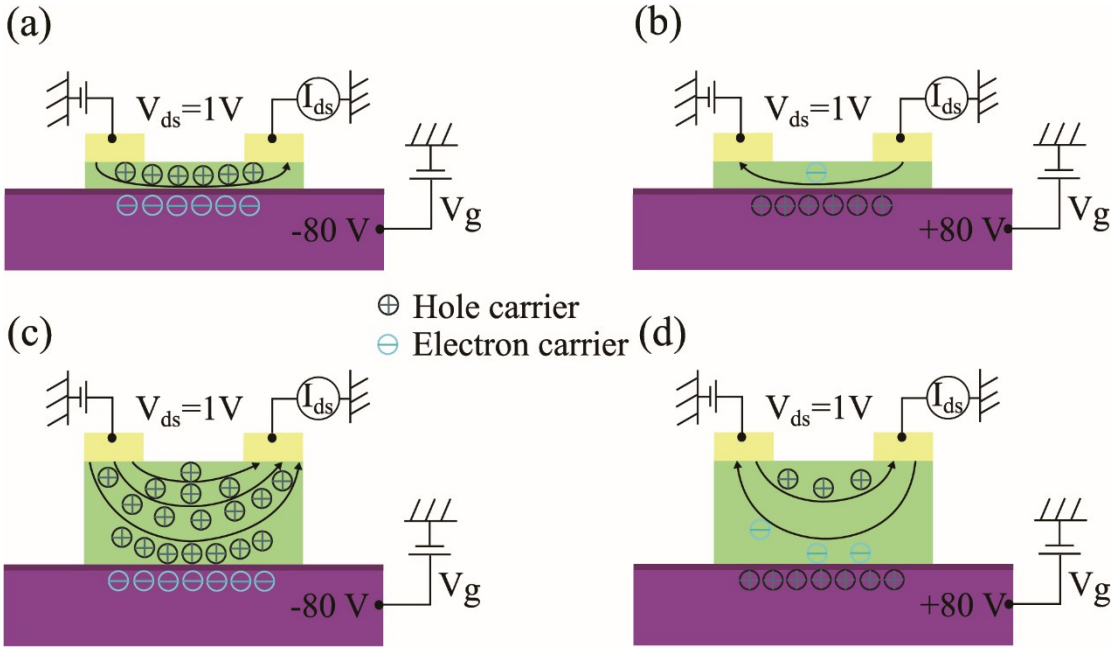

Fig. S11 The microcosmic scheme of FETs devices based on $SnS_{1-x}Se_x$ alloyed samples. (a) and (b) for ultrathin sample. (c) and (d) for thicker sample (larger than 25 nm).