Supplementary Information

Doped 2D SnS Materials Derived from Liquid Metal Solution for Tunable Optoelectronic Devices

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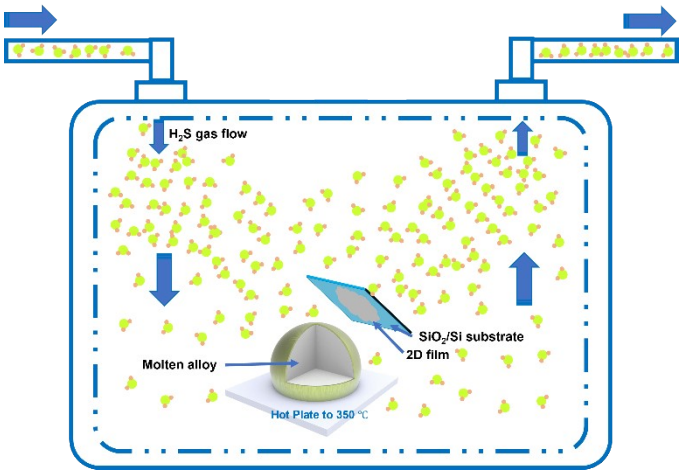
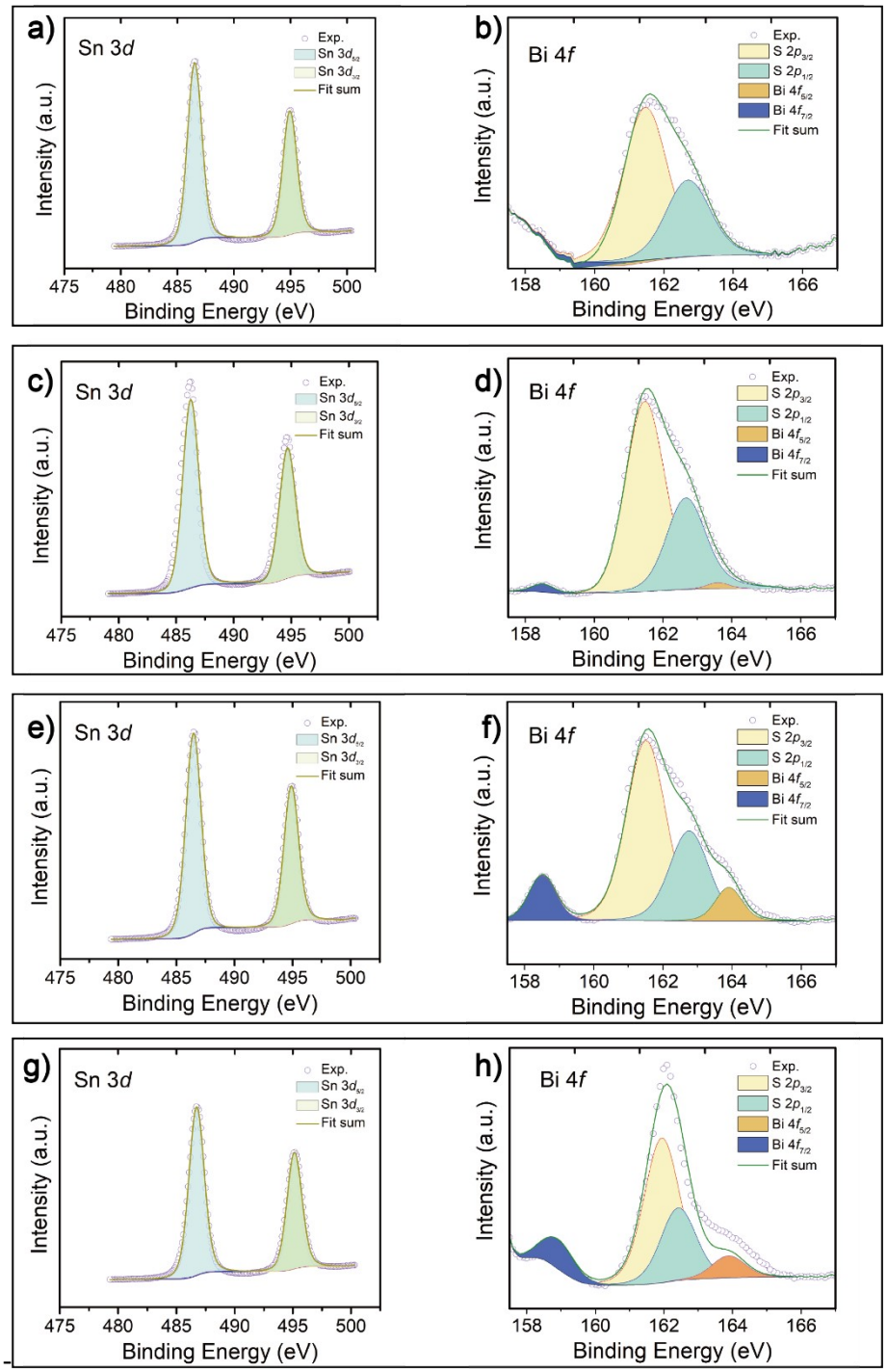
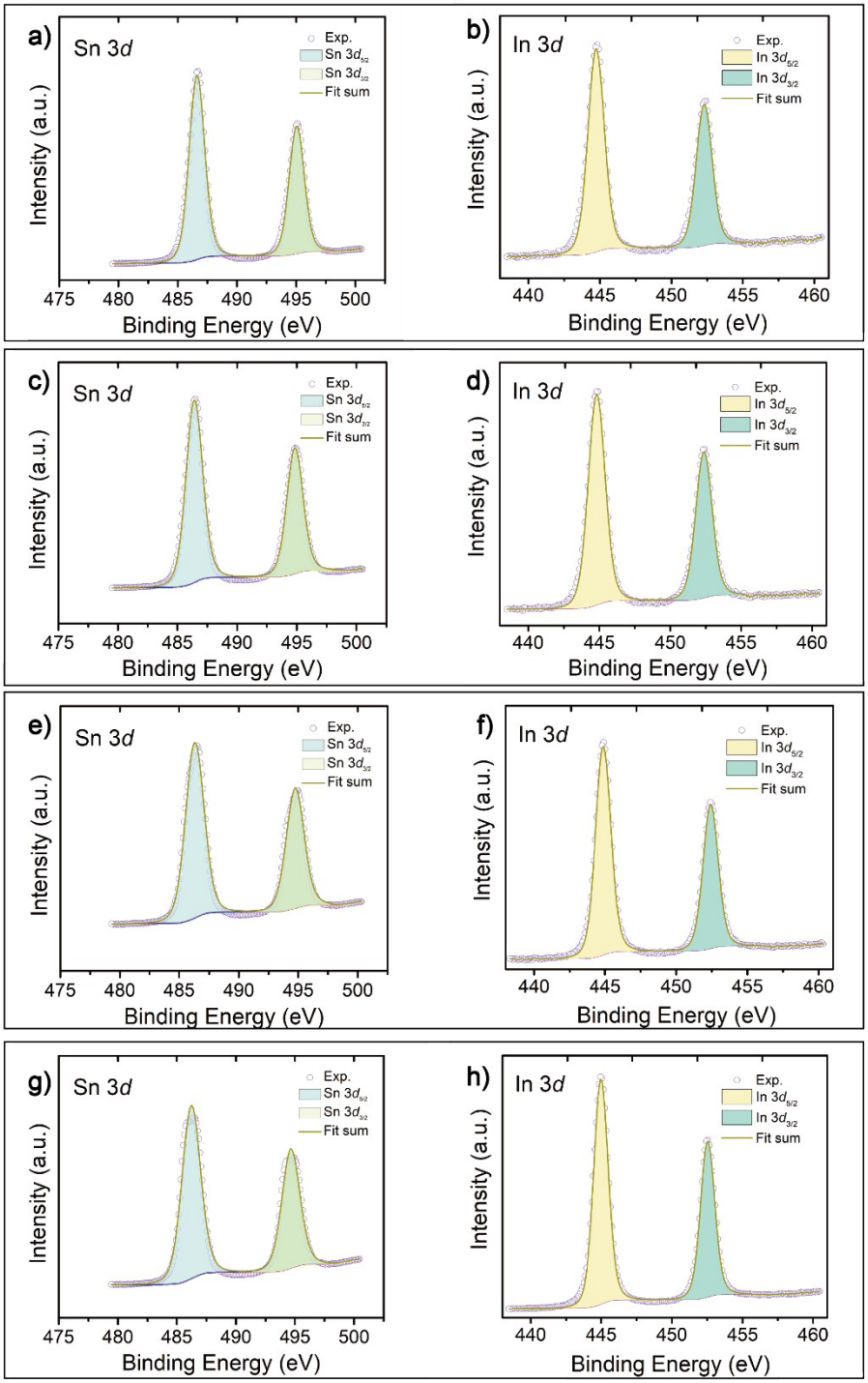


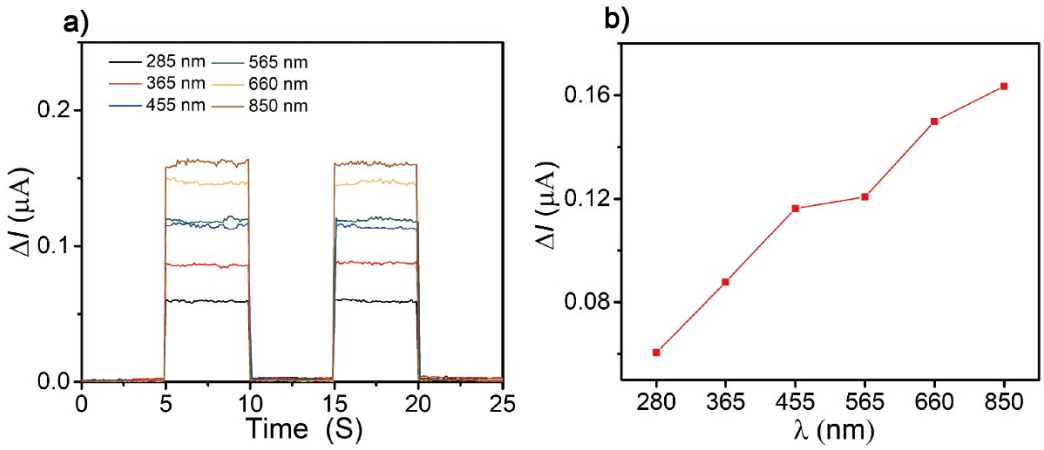
Supplementary Fig. 1. The schematic diagram of the customized glove box providing H_2S environment (H_2S is used in the N_2 environment). 2D doped SnS can be formed on the surface of In and Bi-doped Sn alloy which can be separated using touch printing method.



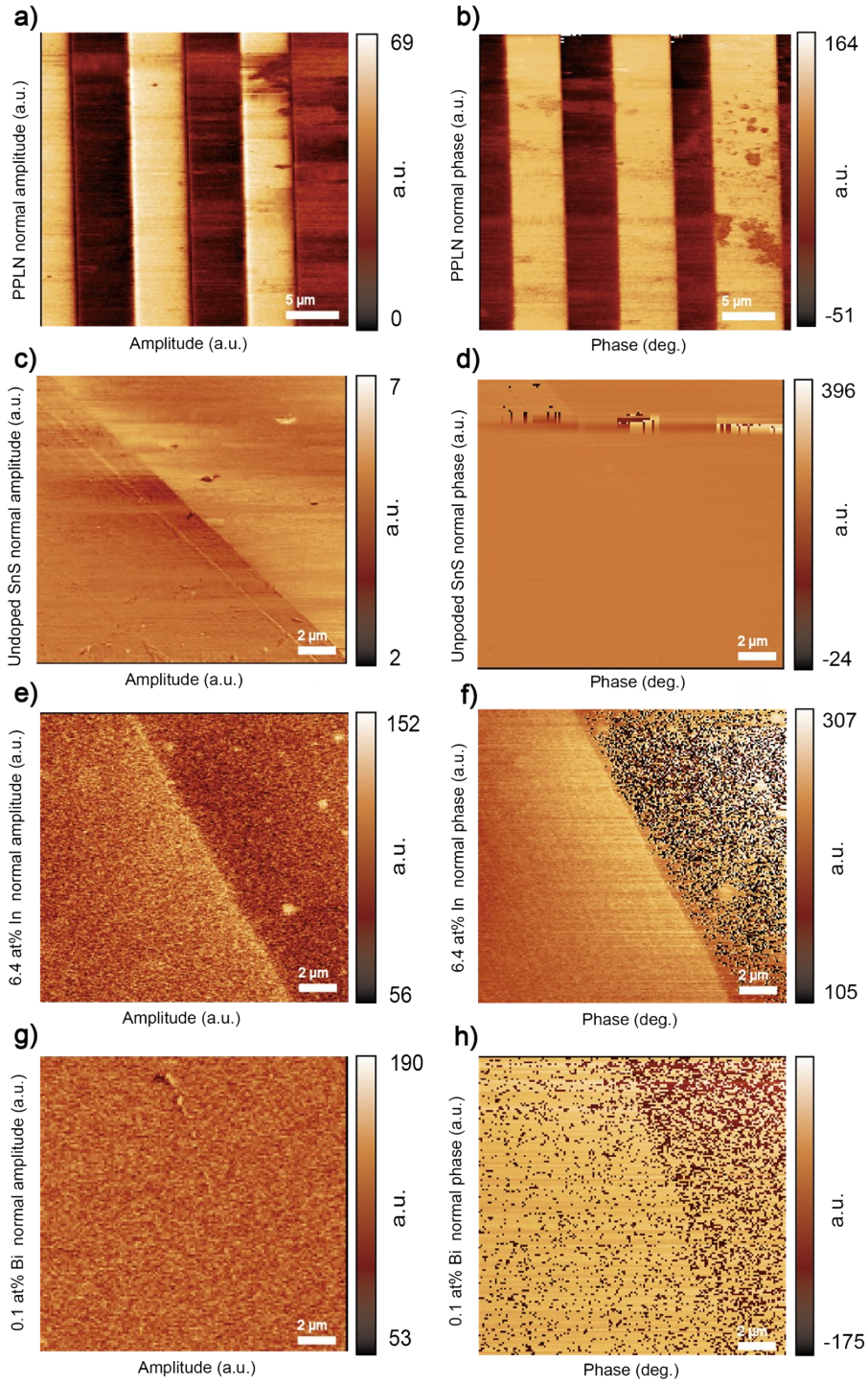
Supplementary Fig. 2. a, c, e and g) The Sn^{2+} XPS spectra of Bi doped SnS nanosheet, the different Bi^{3+} composition in 2D structure are 0 at %, 0.1 at %, 0.4 at % and 0.6 at %. b, d, f and h) The Bi^{3+} XPS spectra of Bi doped SnS nanosheet, the different Bi^{3+} composition in 2D structure are 0 at %, 0.1 at %, 0.4 at % and 0.6 at %.



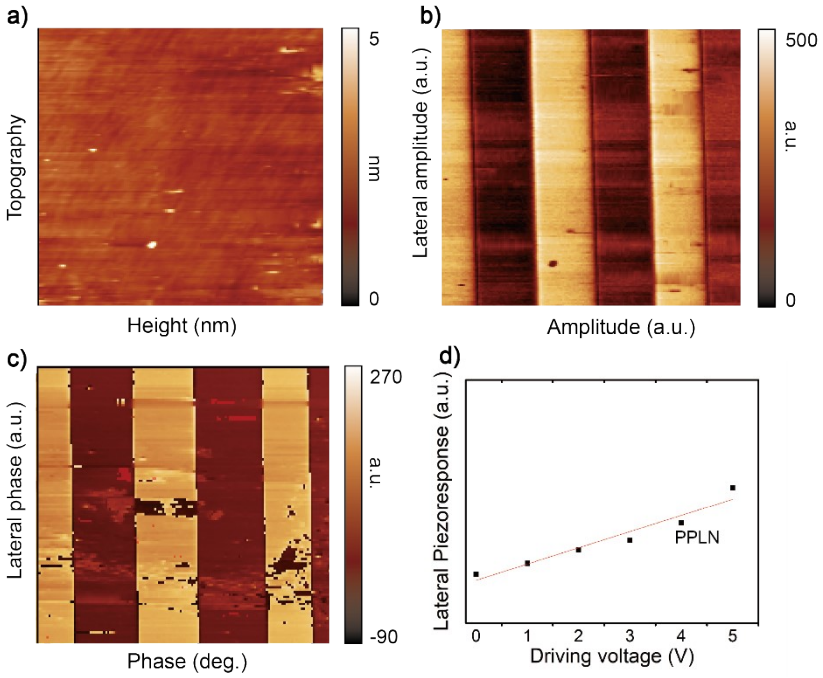
Supplementary Fig. 3. a, c, e and g) The Sn^{2+} XPS spectra of In doped SnS nanosheet, the different In^{3+} composition in 2D structure are 2.4 at %, 6.4 at %, 11 at % and 17 at %. b, d, f and h) The In^{3+} XPS spectra of In doped SnS nanosheet, the different In^{3+} composition in 2D structure are 2.4 at %, 6.4 at %, 11 at % and 17 at %.



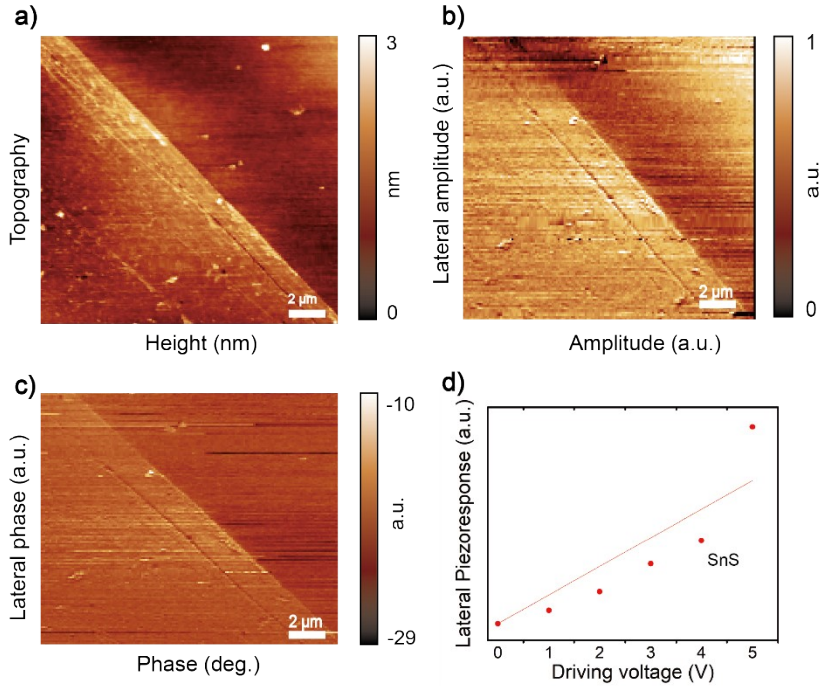
Supplementary Fig. 4. a) Photocurrent at different wavelengths for layers of undoped SnS nanosheet. b) The photocurrent changes were obtained at different wavelengths at Pinc = 2 mW/cm^2 and Vds = 0.5 V for a single layer of undoped SnS nanosheet.



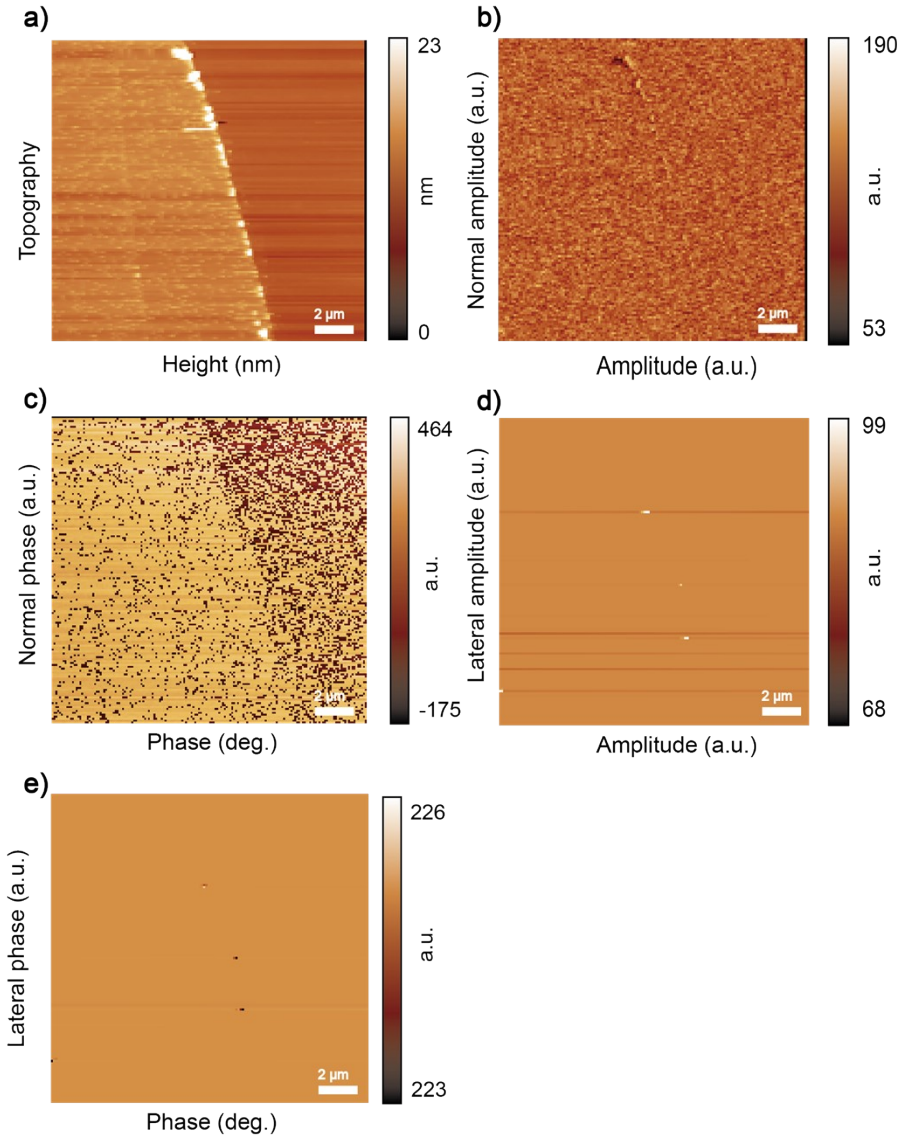
Supplementary Fig. 5. Comparison of the normal amplitude and phase of different types of 0.3 wt% In alloy concentration samples a) The normal amplitude of the standard sample PPLN b) The normal phase of the standard sample PPLN c) The normal amplitude of the undoped SnS nanosheet, histogram with the attached picture. d) The normal phase of the undoped SnS nanosheet, histogram with the attached picture. e) The normal amplitude of the 6.4 at % In concentration in nanosheet, histogram with the attached picture. f) The normal phase of the 6.4 at % In concentration in nanosheet, histogram with the attached picture. g) The normal amplitude of the 0.1 at % Bi concentration in nanosheet, histogram with the attached picture. h) The normal phase of the 0.1 at % Bi concentration in nanosheet, histogram with the attached picture.



Supplementary Fig. 6. a) The morphology of PPLN standard sample. b) Lateral amplitude of PPLN standard sample, histogram with the attached picture. c) Lateral phase of PPLN standard sample, histogram with the attached picture. d) The lateral piezoelectric response of PPLN to different driving voltages.



Supplementary Fig. 7. a) The morphology of undoped SnS nanosheet. b) Lateral amplitude of undoped SnS nanosheet, histogram with the attached picture. c) Lateral phase of undoped SnS nanosheet. d) The lateral piezoelectric response of undoped SnS nanosheet to different driving voltages.



Supplementary Fig. 8. a) The morphology of 0.1 at % Bi- concentration in nanosheet. b) Normal amplitude of 0.1 at % Bi- concentration in nanosheet, histogram with attached picture. c) Normal phase of 0.1 at % Bi- concentration in nanosheet, histogram with attached picture. b) Lateral amplitude of 0.1 at % Bi- concentration in nanosheet, histogram with attached picture. c) Lateral phase of 0.1 at % Bi- concentration in nanosheet, histogram with attached picture.

Supplementary Table 1. Piezoelectric parameters of 2D SnS

2D material	Lateral (pm/V)	Ref
SnS	26.1	(reference#)
SnS	30.61	This work
In-SnS	37.52	This work
Bi-SnS	0	This work