Supporting Information

Tunable WSe₂-CdS Mixed-dimensional van der Waals Heterojunction with Piezophototronic effect for Enhanced Flexible Photodetector

Pei Lin^{a, b}, Laipan Zhu^{a, b}, Ding Li^{a, b}, Liang Xu^{a, b}, and Zhong Lin Wang^{a, b, c,*}

^a CAS Center for Excellence in Nanoscience, Beijing Key Laboratory of Micro-nano Energy and Sensor, Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences, Beijing 100083, P. R. China
^b School of Nanoscience and Technology, University of Chinese Academy of Sciences, Beijing 100049, P. R. China
^c School of Material Science and Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332, United States

E-mail: zhong.wang@mse.gatech.edu



Fig. S1. SEM images of as-grown CdS nanowires. Inset: EDS spectrum for the synthetic material, indicating that Cd and S are the major elements. The atomic percentage of S is less than that of Cd, which implies the presence of sulfide vacancies and *n*-type property of CdS.



Fig. S2. Raman (a) and PL (b) spectra of WSe_2 nanosheet stimulated with 532 nm laser. The data in (b) reveal two peaks, which indicate the indirect (~900 nm) and direct (~780 nm) interband transitions.



Fig. S3. (a) *J-V* characteristics of the WSe₂-CdS diode under dark and different 680 nm optical illumination intensities. (b) Short-circuit current J_{sc} , open-circuit voltage V_{oc} as a function of optical power with the data extracted from (a). (c) Temporal response of the photocurrent generation under 11.74 mW cm⁻² illumination at 0 V bias. (d) Schematic band diagram of WSe₂-CdS and the photovoltaic effect.



Fig. S4. The calculated change in drain current I_{ds} and p-n junction barrier height as a function of strain in dark at +2 V drain bias.



Fig. S5. (a) Photodetection performance change of the device at different heights when illuminating 5.3 mW cm⁻² (calibrated when $\Delta h=0$) laser. The device was moved up or down for different height change (Δh) while keeping the substrate flat, as shown in the inset. (b) Calculated I_{ds} as a function of height change at +2 V drain bias.



Fig. S6. (a) Time-dependent photoresponse of device to 7.89 mW cm⁻² optical illumination under different strains at +2 V drain bias. (b) The corresponding rise and recover time for the device under different strains.



Fig. S7. Fabrication process of 2D WSe₂ nanosheet-1D CdS nanobelt heterostructure on PET substrate, the scale bar is $10 \ \mu m$.