Electronic Supplementary Material (ESI) for RSC Advances.

Supporting information

High-performance flexible photodetectors based on single-crystalline Sb_2Se_3 nanowires

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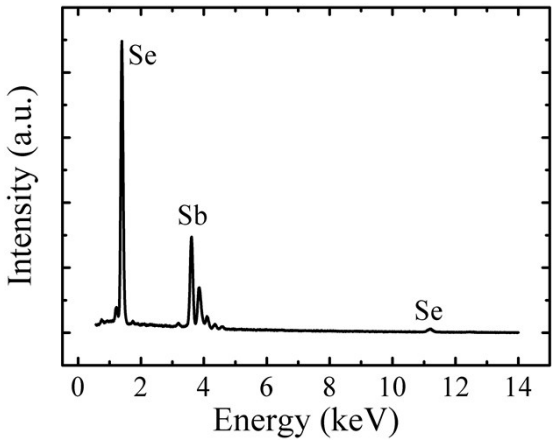

Fig. S1 EDX spectrum of the synthesized product. The product includes elements Sb (40.5 %) and Se (59.5 %). The atomic ratio of Sb and Se is close to the stoichiometry of Sb_2Se_3.

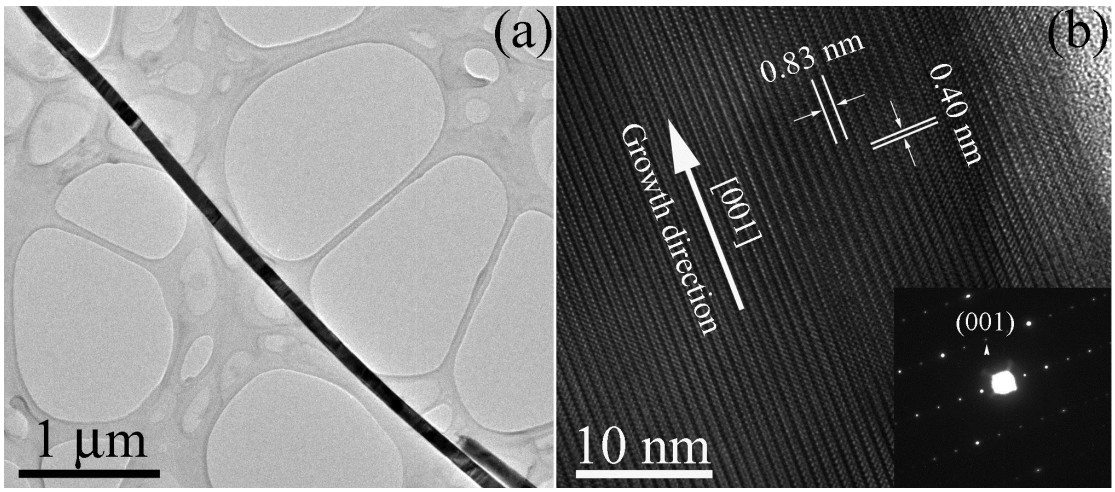

Fig. S2 (a) TEM image of a typical Sb_2Se_3 nanowire. (b) HRTEM image taken from the nanowire in (a). Inset is the corresponding selected area electron diffraction (SAED) pattern. The lattice fringes with an interplanar spacing of 0.40 nm correspond to the (001) plane of orthorhombic Sb_2Se_3. The results confirm that the synthesized nanowires are single-crystalline and grow along the [001] direction.

To calcuate R_λ and *EQE*

Under the illumination of 13 μW/cm^2 635 nm light, the photocurrent (I_{ph}) is 40 pA at a bias of 10 V. As shown in the inset of the Fig. 2, the diameter of the nanowire is 135 nm. The length of the nanowire between two electrodes is 6.4 μm. Thus, the effective illuminated area (S) is $1.35\times10^{-5}\times6.4\times10^{-4}$ cm^{-2}. The power density (P) and wavelength (λ) of the incident light are 13 μW/cm^2 and 635 nm, respectively. Planck's constant (h) is 6.626×10^{-34} J·s, the electronic charge (e) is 1.602×10^{-19} C, the speed of light (c) is 2.998×10^{8} m/s.

$$R_\lambda = \frac{I_{ph}}{PS} = \frac{4.0\times10^{-11}}{1.3\times10^{-5}\times1.35\times10^{-5}\times6.4\times10^{-4}} A/W \approx 360 A/W$$

$$EQE = \frac{hcR_\lambda}{e\lambda} = \frac{6.626\times10^{-34}\times2.998\times10^{8}\times360}{1.602\times10^{-19}\times6.35\times10^{-7}} \approx 7.0\times10^{4}\%$$

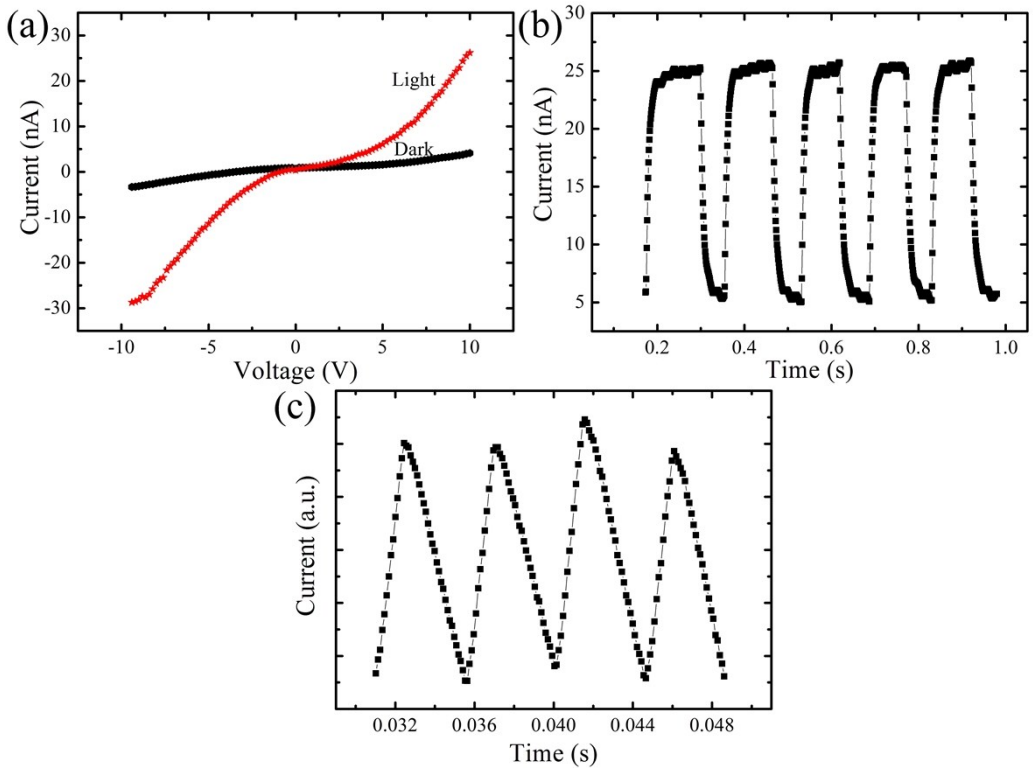

Fig. S3 (a) *I-V* curves of a multiple Sb_2Se_3 nanowires based photodetector (DS1) in the dark and under the illumination of 635 nm light. (b,c) Time responses of DS1 measured at a bias of 10 V under the illumiantion of chopped 635 nm light. From (b), it can be deduced that DS1 can detect 635 nm light repeatedly and its rise/fall time is 13/20 ms. (c) *I-t* curve shows that the photodetector has ability to detect 635 nm light with an on-off frequency up to 230 Hz.

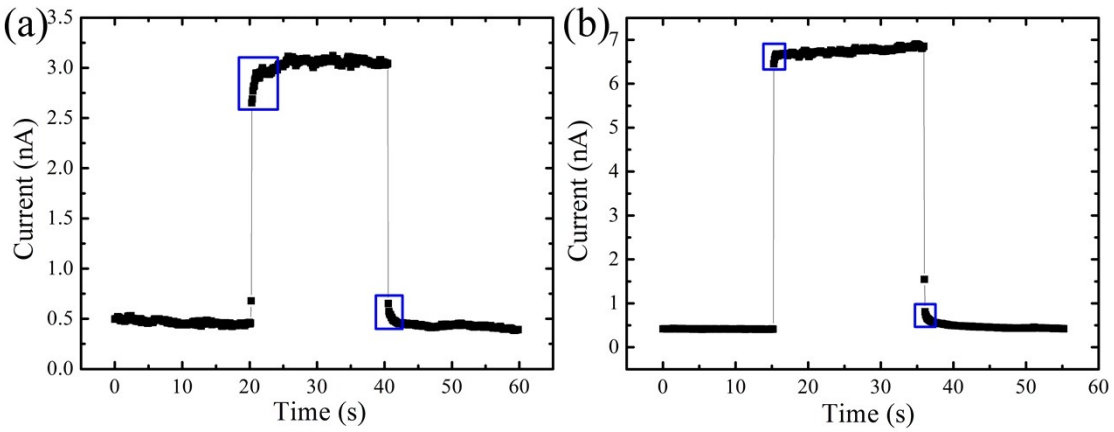

Fig. S4 (a) Time response of a multiple Sb_2Se_3 nanowires based photodetector (DS2) to 65 mW/cm^2 635 nm light at a bias of 10 V. (b) Time response of another multiple Sb_2Se_3 nanowires based photodetector (DS3) to 67 mW/cm^2 635 nm light at 10 V. It is obvious that the number of nanowires in the DS3 is more than that in the DS2. For the DS2, there are a longer rise tail and an obvious fall tail marked by two blue rectangles, as shown in (a). Thus, the response speed of the DS2 is slower than that of the DS3. As the power densities of incident 635 nm light, the applied voltages and photodetector's configurations are similar, the difference of response speed between the DS2 and the DS3 is related to the number of nanowires in photodetectors. It can be concluded that increasing the number of nanowires in the photodetector can improve response speed.

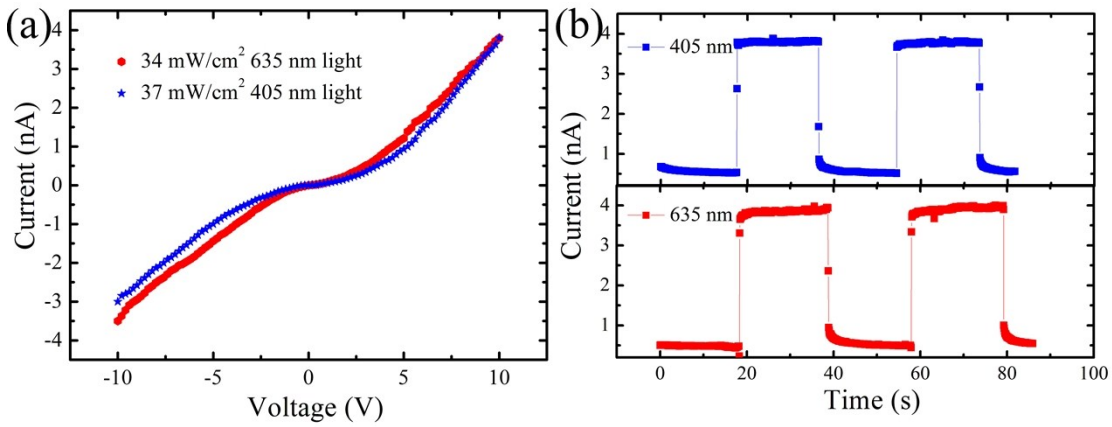

Fig. S5 (a) *I-V* curves of the DS3 under the illuminations of 34 mW/cm^2 635 nm light and 37 mW/cm^2 405 nm light. (b) The time responses of the DS3 to 405 nm light and 635 nm light, respectively. (a) and (b) indicate that the response of the DS3 to 405 nm light is similar to that to 635 nm light.