Supporting Information

Thermal Evaporation of Large Area SnS_2 Thin Films with a UV-to-NIR Photoelectric Response for Flexible Photodetector Applications

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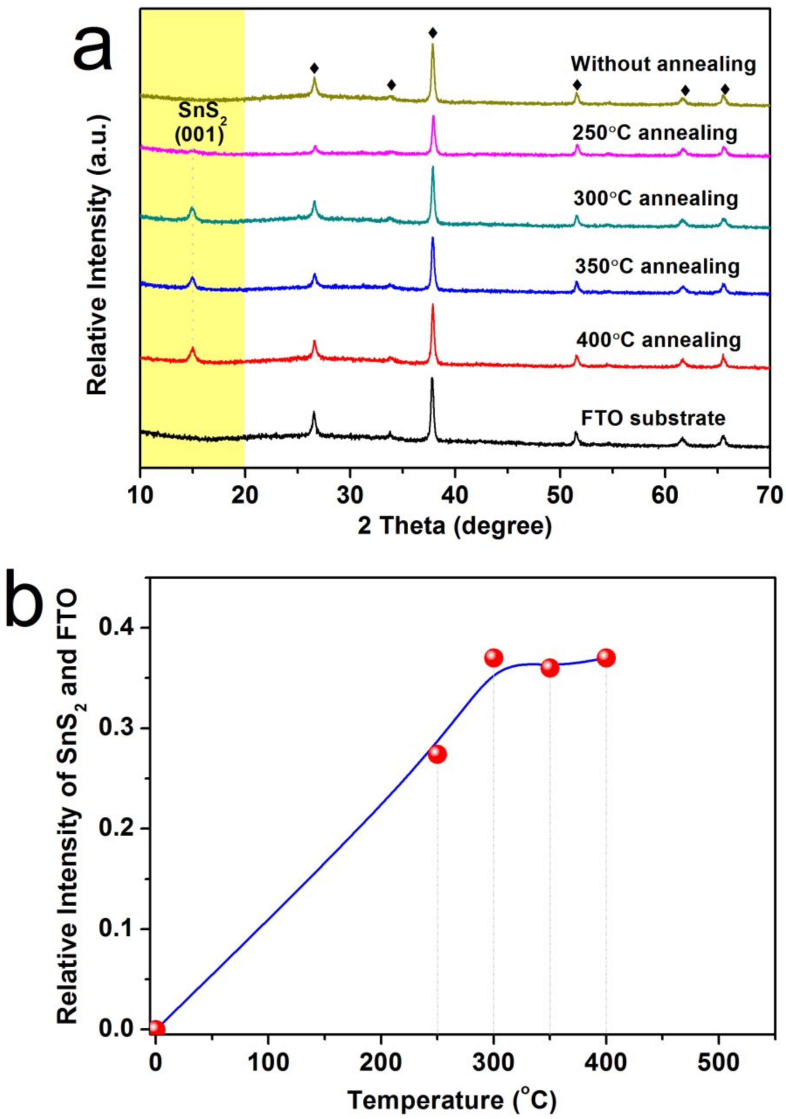

Figure S1. XRD patterns of the SnS_2 thin films treated with different temperatures (a); the intensity ratio of diffraction peaks of SnS_2 and FTO (b).

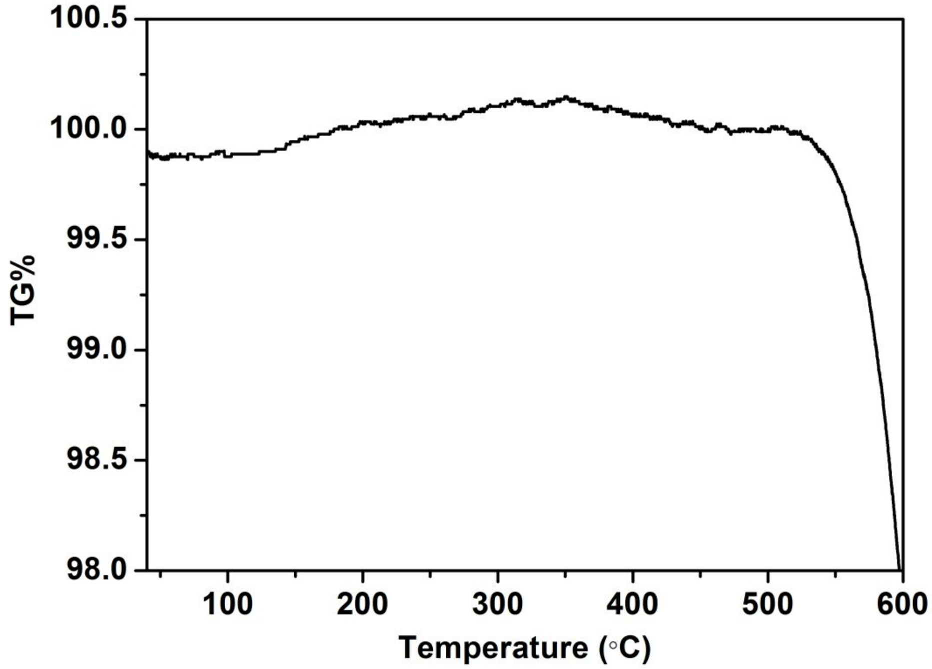

Figure S2. TG curve of SnS_2 powder.

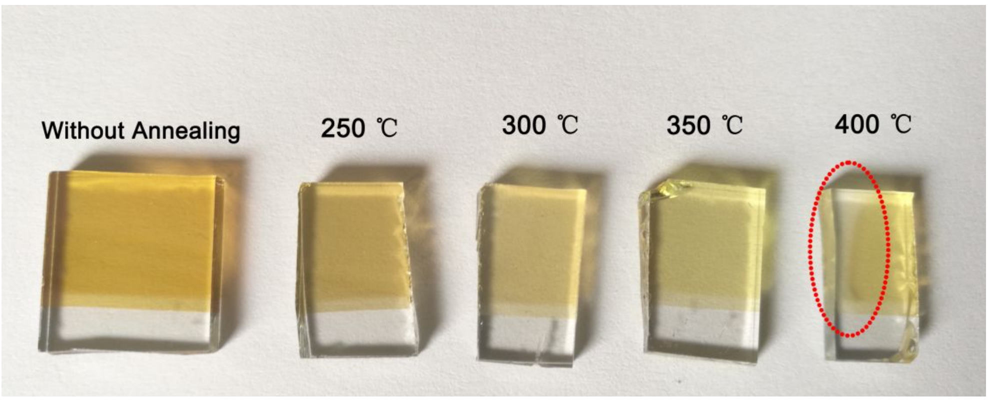

Figure S3. Photographs of the SnS_2 thin films on FTO substrate annealed at different temperatures. (Part of the SnS_2 thin film is missing in the red oval.)

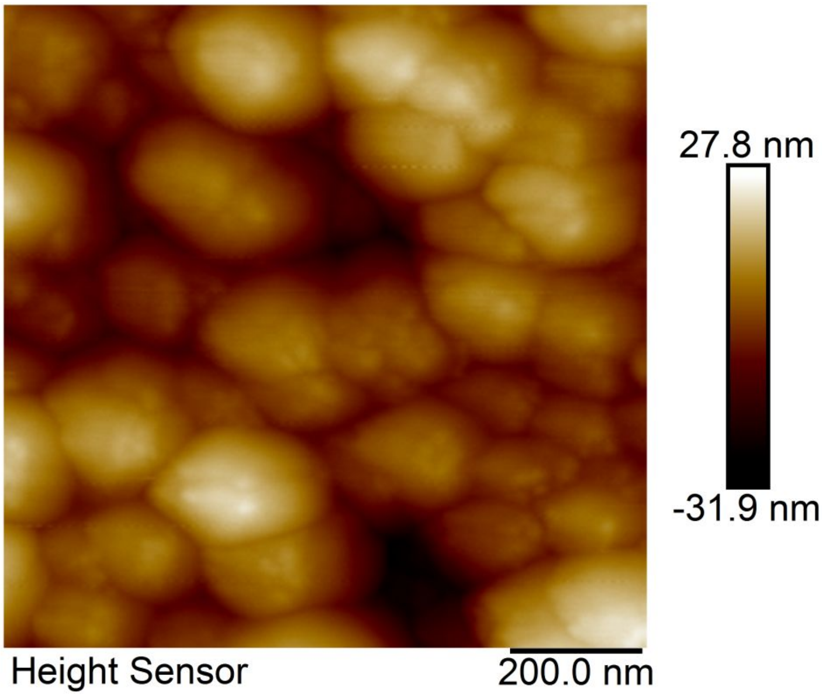

Figure S4. AFM image of SnS_2 annealed at 350 °C.

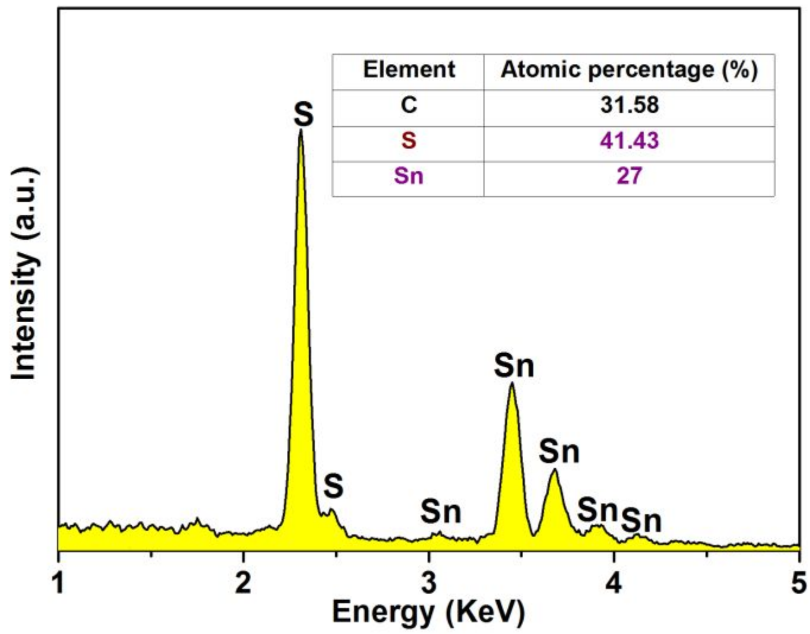

Figure S5. EDS results of the SnS_2 thin film annealed at 350 °C.

In this work, by using of different substrates for SnS_2 thin film fabrication, the influence of substrates on SnS_2 thin films growth have been compared. The following three aspects may affect the thin film growth on different substrates, *elements* *diffusion*, *textured substrate* and *surface tension of the substrates*. In this work, SnS_2 was thermally evaporated onto different substrates (FTO and PI) for further characterization and flexible photodetector devices fabrication. Considering the above three aspects, the following conclusion can be obtained: (1) No elements diffusion occurs during the thermal annealing treatment of SnS_2 thin films on FTO and PI. FTO is a widely used substrate that can be annealed up to 450 °C without change. PI substrate can be annealed up to 400 °C without change. Therefore, the elements in FTO and PI substrates will not diffuse into SnS_2 layer. (2) There are no textured character in FTO and PI substrate. (3) Indeed, the surface tension of the FTO and PI may be different. But the XRD results of the SnS_2 samples on FTO and PI show only one diffraction peak of SnS_2 at 14.9°, and the calculated crystallite size of the samples are almost the same (around 110 nm). Based on these results, we deduced that surface tensions of the FTO and PI do not influence on the SnS_2 thin film growth during annealing.

To further understand the orientation character of the resulting SnS_2 thin films, we in-situ fabricated the SnS_2 thin films on Mo grid substrate which is stable enough with thermal annealing. The diameter of the holes in Mo grid is about 50 μm which is broad enough for HRTEM and SAED measurements. During thermal annealing, even some MoS_2 generated on Mo framework which can not influence the crystallization of SnS_2 that located at the center of the holes. Therefore, we can conclude that the Mo grid substrate do not affect the SnS_2 thin film fabrication. From the TEM image we can find that the resulted SnS_2 thin film covers the whole Mo grid continuously. The SnS_2 thin film near the center of the hole was selected for HRTEM and SAED measurements. The corresponding results show that the obtained SnS_2 thin films are highly (001) plane oriented which is in accord with the XRD results. Therefore, we have come to the conclusion that the effects of substrates on SnS_2 fabrication can be ignored.

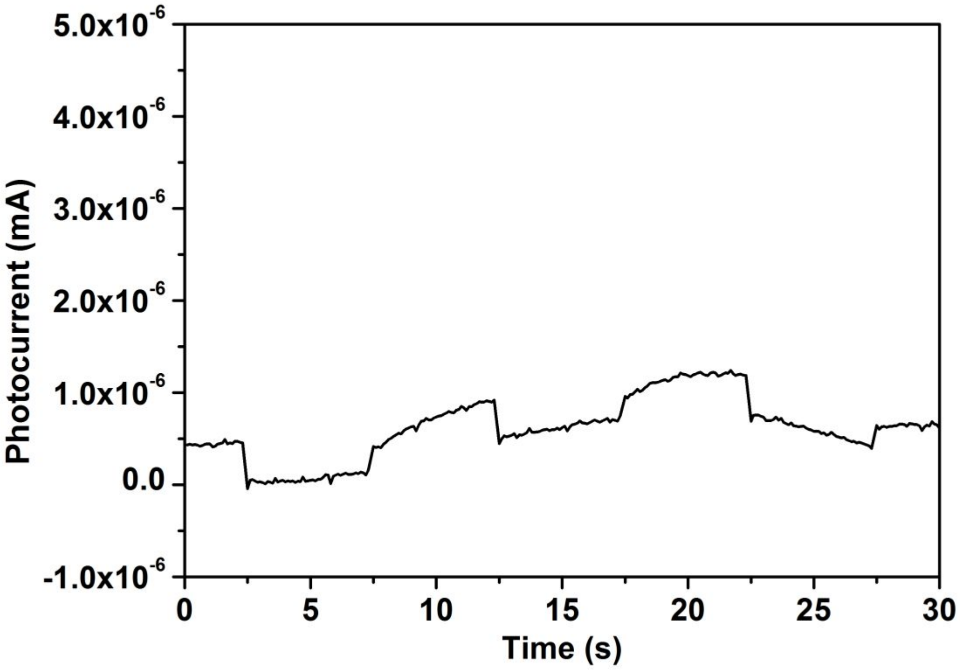

Figure S6. Photocurrent response of the photodetector based on as-deposited amorphous SnS_2 without thermal annealing.