

Supplementary Information

A solution-processed TiS₂/organic hybrid superlattice film towards flexible thermoelectric devices

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XRD analysis

XRD measurement has been performed on the mixed TiS₂/hexylamine (HA) powder after grinding. The experimental result is presented in Fig. s1, which shows that the resultant powder consists of intercalated TiS₂[HA] phase with larger d-spacing as well as a small amount of un-intercalated TiS₂ phase. Fig. s2 compares the XRD pattern of pristine TiS₂ crystal and as-deposited film, which clearly shows the peak shifting towards low angle direction after organic intercalation.

Weight loss

We have annealed the film sample at 130 °C in vacuum and measured the weight change as a function of annealing time. The result is presented in Fig. s3, which demonstrates the remarkable weight loss during annealing.

Evolved gas analysis

In order to further identify the organic substances and their stability in the film, we have performed the evolved gas analysis by gas chromatography-mass spectrometer (GC-MS). The 6h-annealed sample was scratched from substrate and loaded into a pyrolyzer system (Frontier Lab PY-2020iD) coupled with a GC-MS. The sample was heated up to 600 °C in nitrogen with a heating rate of 15°C/min. The extracted ion chromatograms of m/z 30 and m/z 59 signals are presented in Fig. s4, in which the former can be assigned to hexylamine (HA) and the latter is N-methylformamide (NMF). It clearly shows that most of NMF molecules were removed from the film at temperatures below 300°C, while HA was mainly extracted from the film at temperatures above 300°C, although NMF has a higher boiling point than HA.

I-V curves of flexible thermoelectric module

The I-V curves of our flexible device were recorded by a programmable Keithley 4200-SCS analyzer at different temperature gradient in the range of 10-70K and the result is presented in Fig. s5.

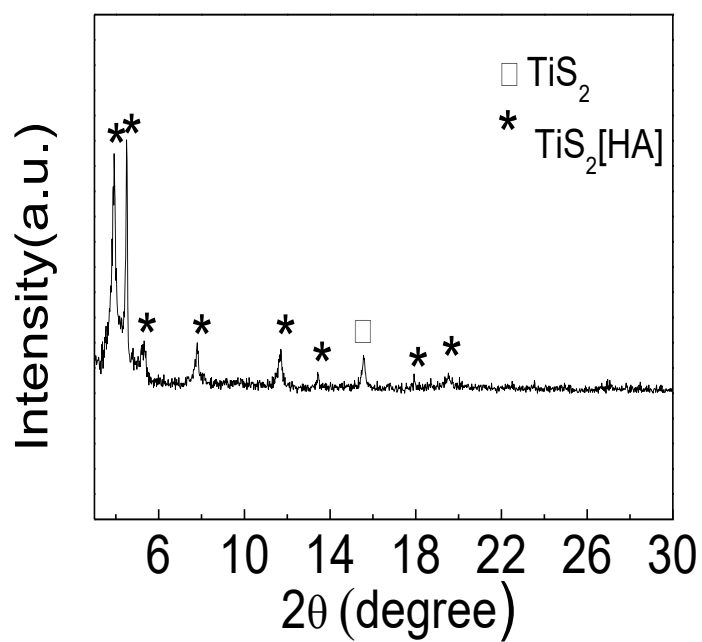


Fig. s1 XRD pattern of mixed TiS_2 and hexylamine (HA) powder after grinding

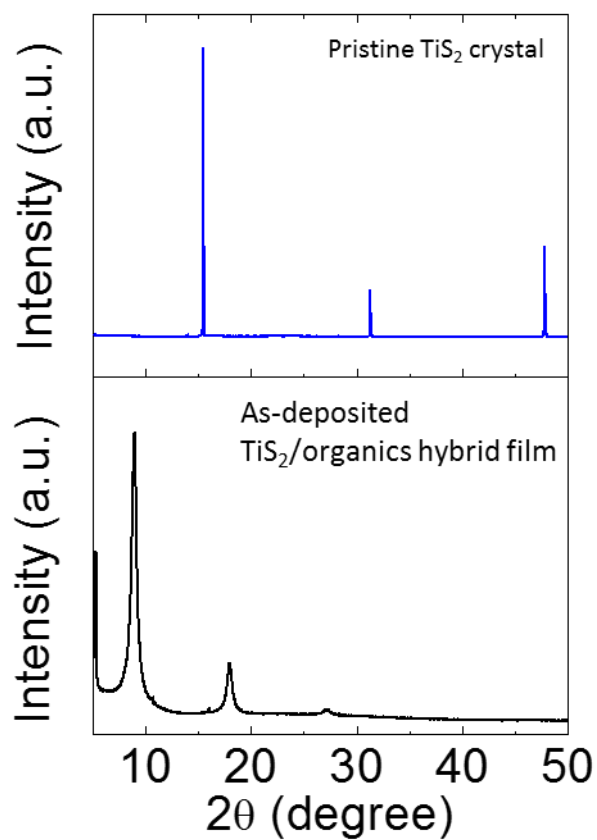


Fig. s2 XRD pattern of pristine TiS_2 crystal (upper panel) and $\text{TiS}_2/\text{organics}$ hybrid film (lower panel).

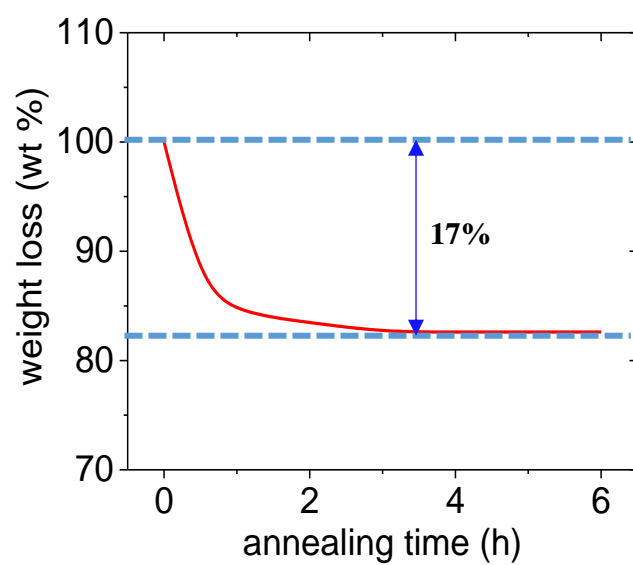


Fig. s3 The weight loss change of as-deposited film as a function of annealing time.

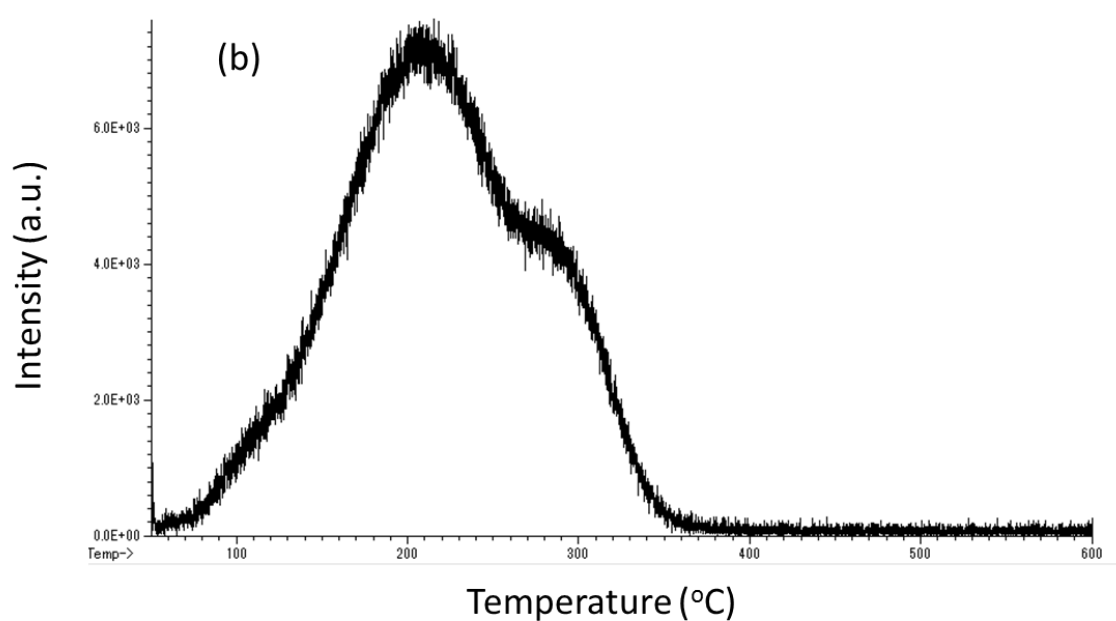
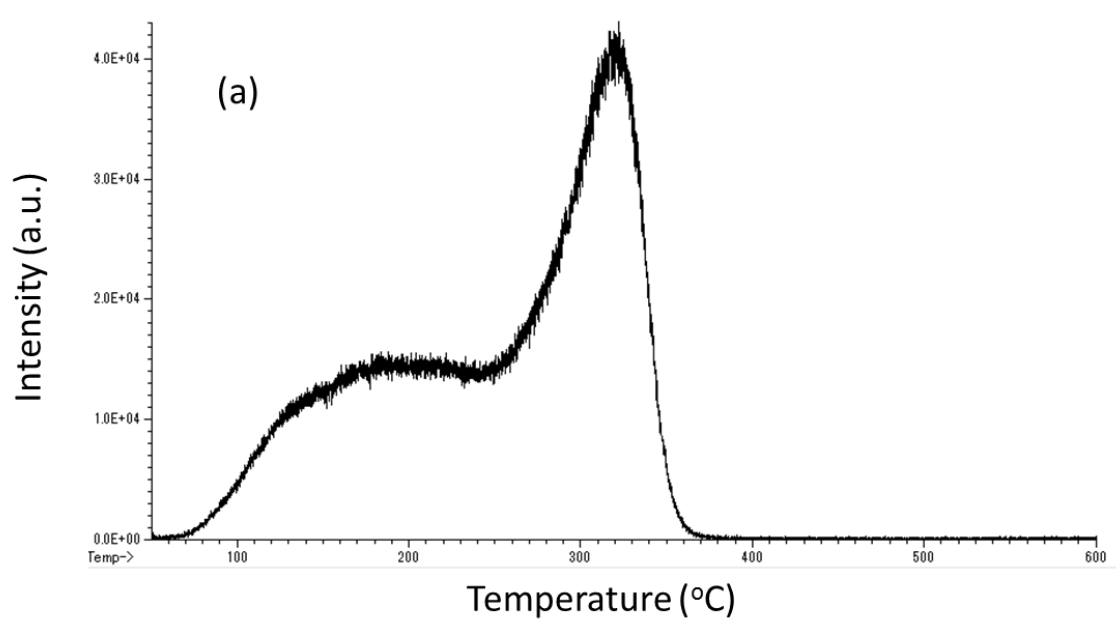


Fig.s4 The extracted ion chromatogram of (a) m/z 30 and (b) m/z 59 signals as a function of temperature.

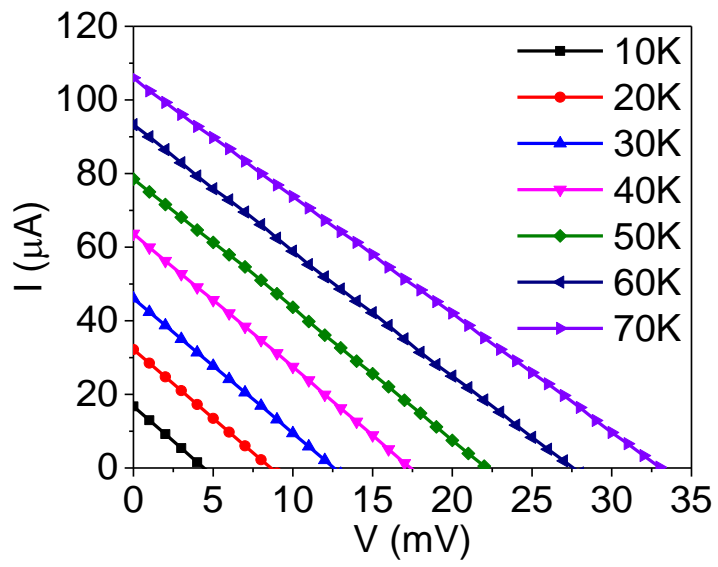


Fig. s5 The measured I-V curves of our flexible thermoelectric module at different temperature gradient.