**Supplementary Information for**

# Rolling-Enabled High-Performance Free-Standing $Ag_2Se$/PVDF Composite Films for Flexible Thermoelectric Devices

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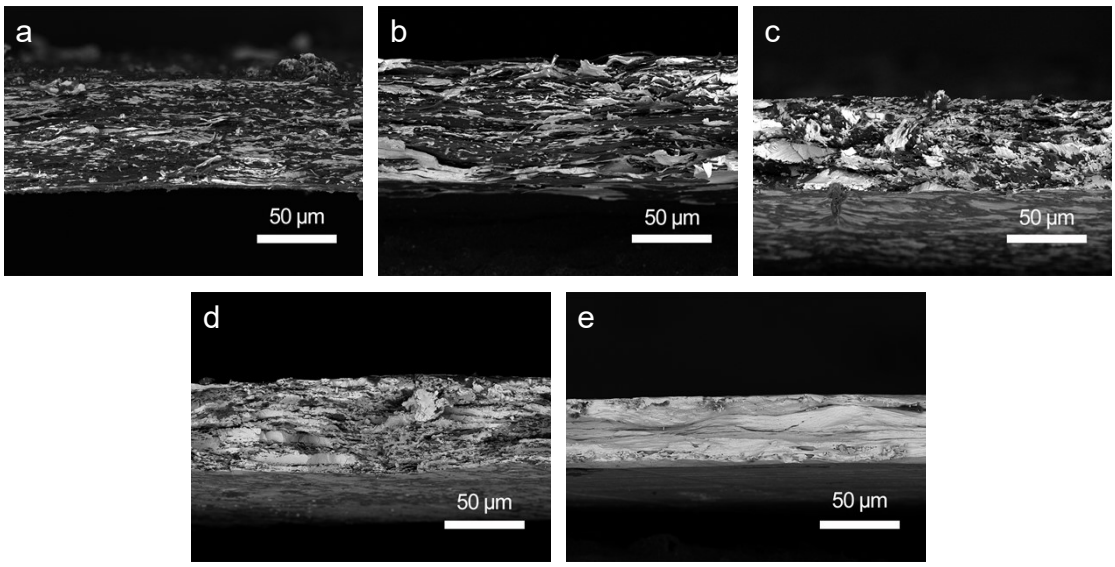


Fig. S1 Cross-sectional SEM images of the (a) R-80, (b) R-85, (c) R-90, (d) R-95, and (e) R-100 samples.

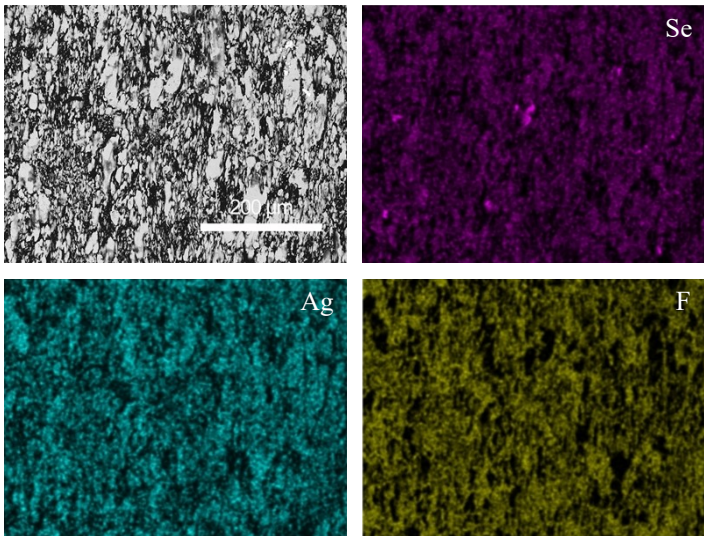


Fig. S2 SEM image and EDS mappings of Se, Ag and F atoms of the R-90 film.

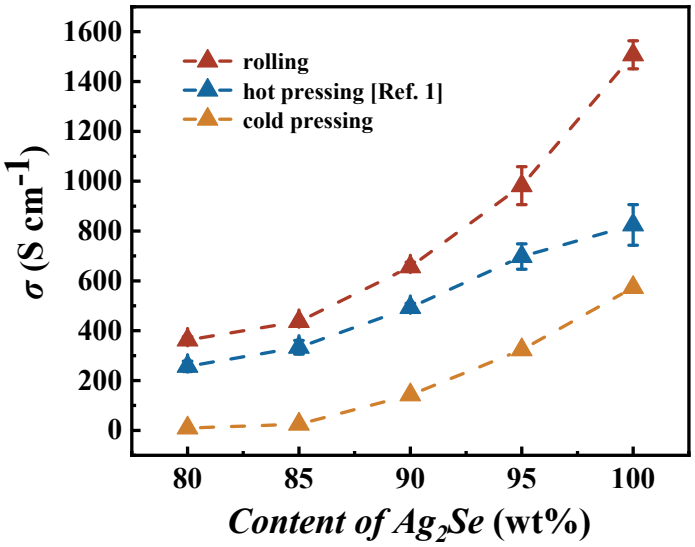


Fig. S3 Comparison of room-temperature electrical conductivity of $Ag_2Se$/PVDF composite films fabricated by different processes[1].

As shown in Fig. S3, the electrical conductivity of the samples before hot rolling (i.e., after cold pressing but prior to rolling) were measured. Under the same mass ratio and measurement conditions, the cold-pressed sample exhibited a room-temperature electrical conductivity of only 142.7 $S \cdot cm^{-1}$, while the hot-rolled R-90 sample reached 656.5 $S \cdot cm^{-1}$, representing an approximately 4.6 times enhancement. In addition, we surveyed literature data on $Ag_2Se$/PVDF composites with the same mass ratio prepared by the hot-pressing method reported in Ref. 1[1]. It was observed that the room-temperature electrical conductivity of a hot-pressed sample with 90 wt% $Ag_2Se$ content was 493.0 $S \cdot cm^{-1}$. In comparison, the electrical conductivity of our hot-rolled sample is significantly higher than this reported value.

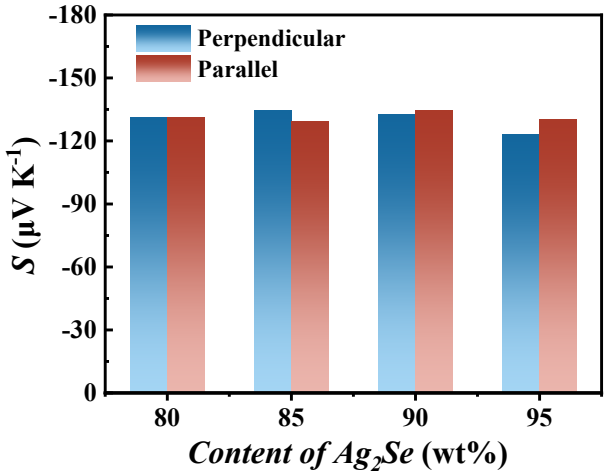


Fig. S4 Seebeck coefficient of $Ag_2Se$/PVDF composite films measured parallel and perpendicular to the rolling direction.

**Note S1. Synthesis of Se NWs[2]**

1 g $SeO_2$ and 1 g β-cyclodextrin were dissolved in 200 mL of deionized water to form solution A. Completely dissolved 4 g of L-(+)-ascorbic acid in 200 mL of deionized water to form solution B. After thorough mixing, slowly added solution A into solution B and react for 4 h. After the reaction, the supernatant was removed by standing the solution, and the remaining sediment was washed by centrifugation with deionzied water and ethanol alternately for 8 times at 4000 rpm to ensure that impurities were removed. The washed Se NWs were dried at 353 K for 24 h.

**Supplementary References**


1. N. Kim, J. Won, Y. Mun, Y. A. Kang, H.-S. Kim, J. Kim and K.-S. Jang, *ACS Appl. Mater. Interfaces*, 2025, **17**, 56359-56369.
2. Y. F. Ding, Y. Qiu, K. F. Cai, Q. Yao, S. Chen, L. D. Chen and J. Q. He, *Nat. Commun.*, 2019, **10**, 841.