Supporting information

Compositionally tuned hybridization of n-type Ag^0:Ag_2Se at ambient conditions towards excellent thermoelectric properties at room temperature

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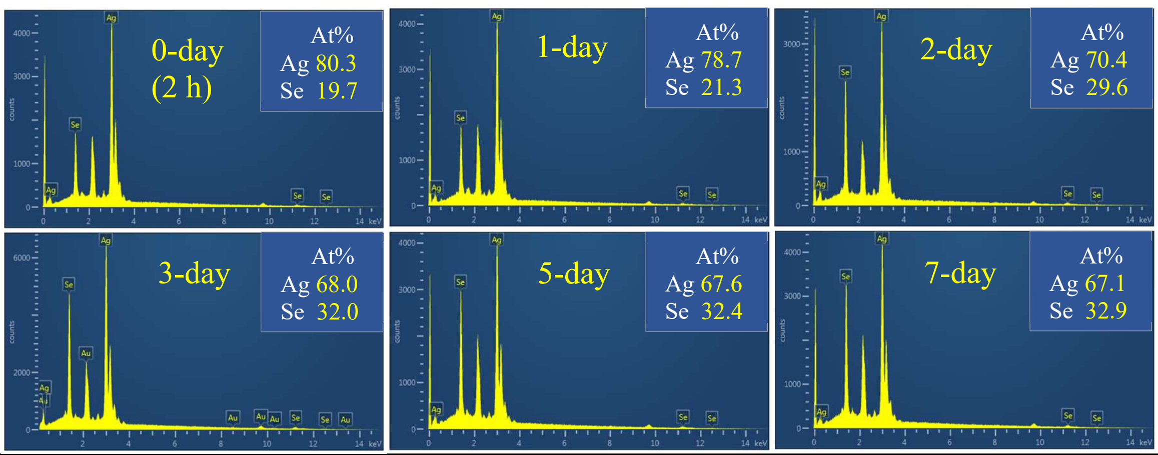

Fig. S1. SEM EDX spectra of the as-synthesized Ag^0:Ag_2Se powders obtained after reaction for 2, 24, 48, 72, 120, and 168 h (denoted as Day 0-, 1-, 2-, 3-, 5-, and 7-day in the figure), possessing the molar ratios of Ag/Se of 4.07, 3.69, 2.38, 2.13, 2.09, and 2.04, respectively.

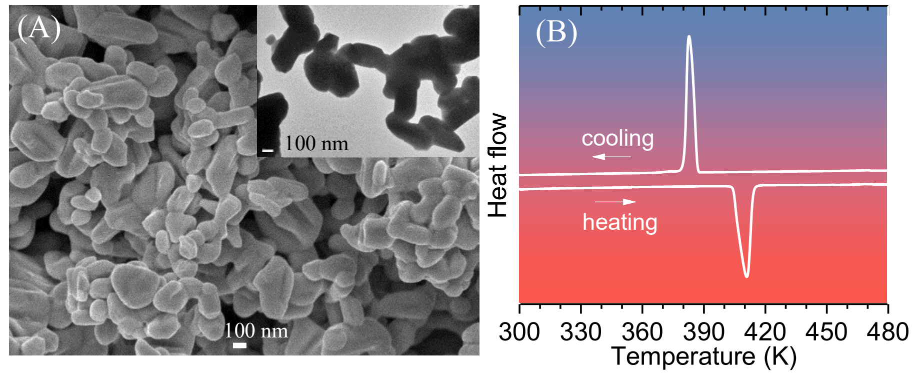

Fig. S2. (A) SEM and TEM (inset) images of the as-synthesized 1.96% Ag^0:Ag_2Se powder at room temperature after 7 days of reaction. (B) Differential scanning calorimetry (DSC) thermogram of 1.96% Ag^0:Ag_2Se powder.

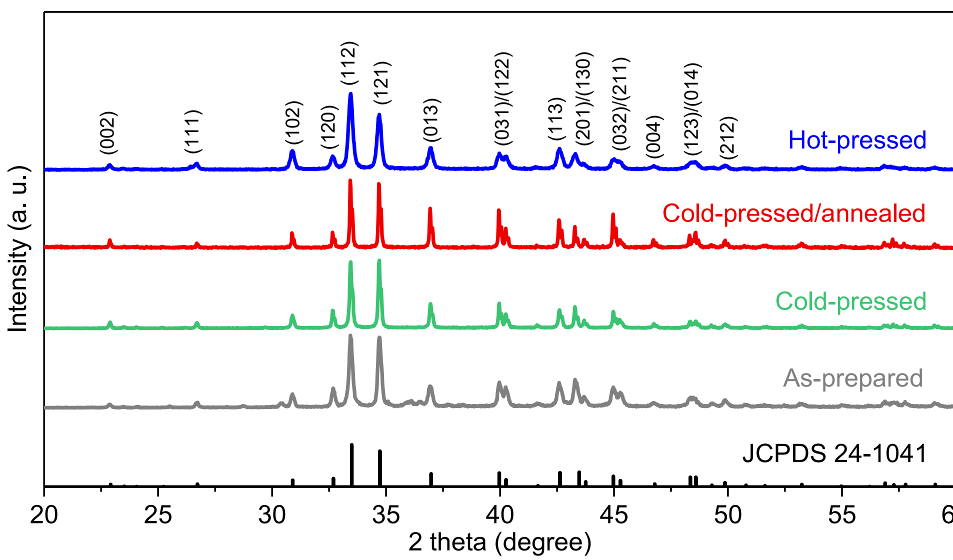

Fig. S3. XRD patterns of the as-synthesized 1.96% Ag^0:Ag_2Se powder (after 7 days of reaction), cold-pressed pellet (RT, 303 K), cold-pressed/annealed pellet (200 °C), and hot-pressed pellet (SPS at 200 °C).

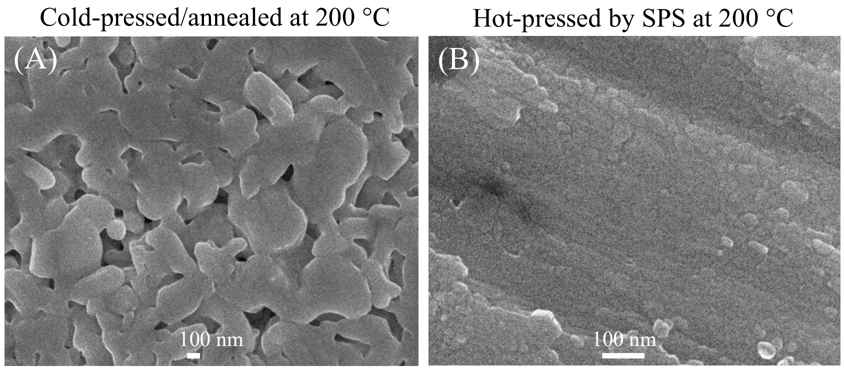

Fig. S4. SEM images of 1.96% Ag^0:Ag_2Se pellet after (A) cold-pressed/annealed at 200 °C and (B) hot-pressed at 200 °C by SPS.

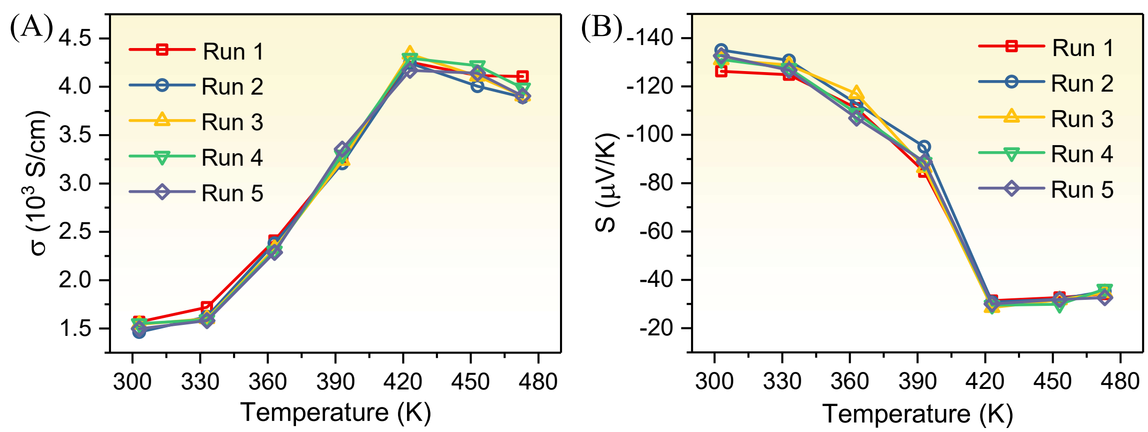

Fig. S5. Thermoelectric performance of 1.96% Ag^0:Ag_2Se pellet for 5 cycles (A) temperature-dependent σ and (B) temperature-dependent S.

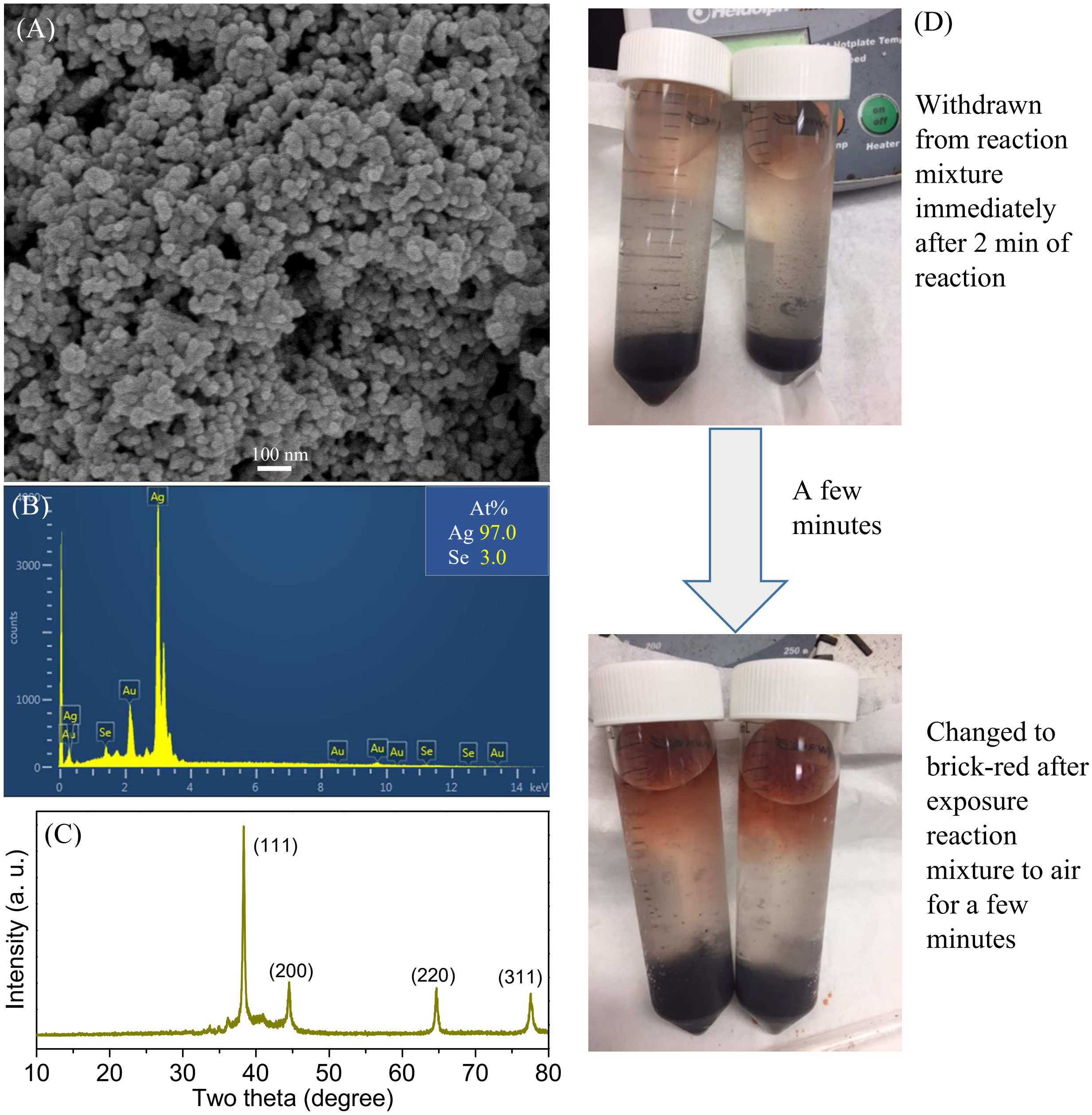

Fig. S6. (A) SEM image, (B) EDX spectrum and (C) XRD pattern of the as-synthesized 93.81% Ag^0:Ag_2Se nanoparticles for 2 min of reaction of $NaBH_4$ with $AgNO_3$ in the presence of HSe^-. (D) Optical images of the as-synthesized 93.81% Ag^0:Ag_2Se after 2 min of reaction, and upon exposure of freshly formed Ag^0 nanoparticles to air for a few minutes.

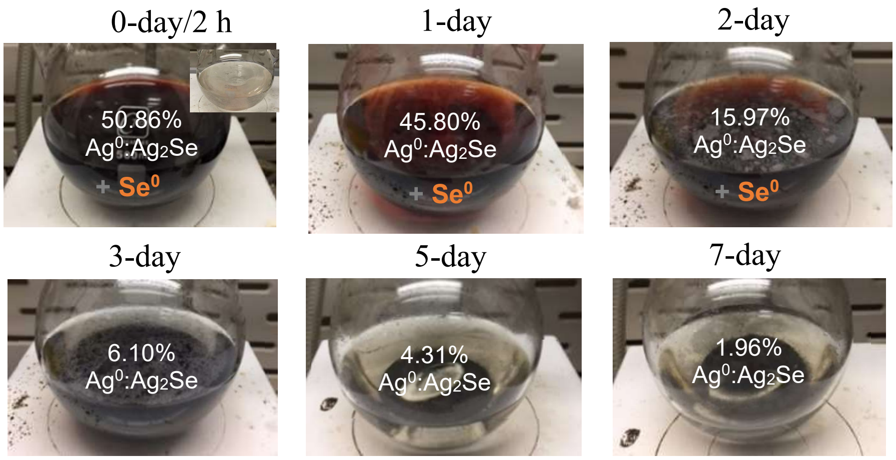

Fig. S7. Optical images of the as-synthesized Ag^0:Ag_2Se after reaction at room temperature for 0, 1, 2, 3, 5, and 7 days, corresponding to excessive Ag^0 at 50.86%, 45.80%, 15.97%, 6.10%, 4.31%, and 1.96%, respectively. Inset is the colourless solution of Na_2Se after chemical reduction of Na_2SeO_3 by $NaBH_4$.

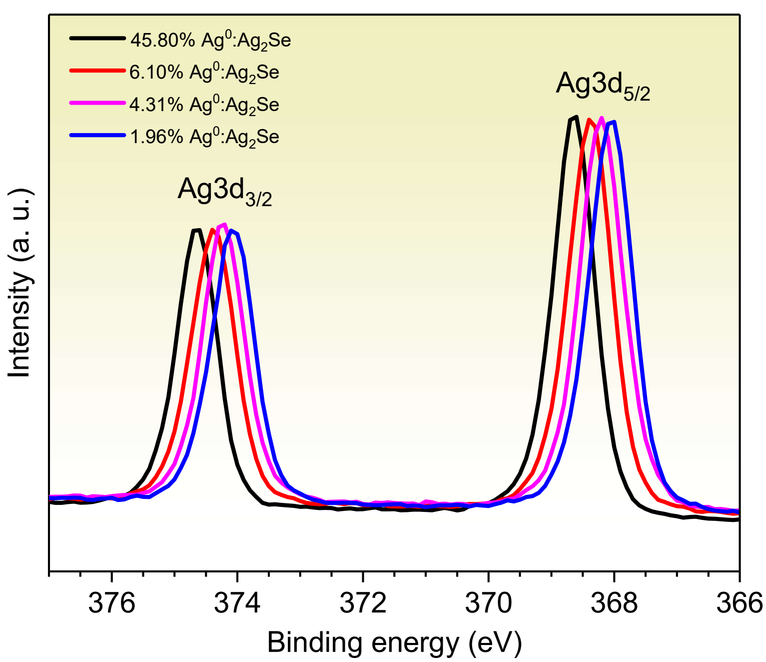

Fig. S8. Ag 3d XPS spectra of the as-synthesized Ag^0:Ag_2Se powders with excessive Ag^0 at 93.81%, 6.10%, 4.31%, and 1.96% after reaction for 2 min, 3 days, 5 days, and 7 days, respectively.

Table S1. Literature comparison between our work with bulk Ag_2Se and hybridized Ag_2Se

Materials	Figure of merit (ZT)	Synthesis method	Ref.
Ag_2Se			
Ag_2Se	0.6 (300 K)	Hydrothermal	1
Ag_2Se	0.13 (300 K)	Colloidal synthesis	2
Ag_2Se	0.45 (323 K)	Chemical synthesis	3
Ag_2Se	0.55 (300 K)	Colloidal synthesis	4
Ag_2Se	0.7 (317 K)	Solvothermal	5
Ag_2Se	0.514 (300 K)	Chemical synthesis	6
Ag_2Se hybridized with other inorganic components			
1.96% Ag^0:Ag_2Se	0.89 (303 K)	Chemical synthesis	Our work
$(Cu_2Se)_{0.05}/(Ag_2Se)_{0.95}$	0.15 (300 K) 0.45 (875 K)	Microwave-assisted thermolysis	7
Ag_2Se/Ag/CuAgS/nylon	0.5 (300 K)	Chemical synthesis	8
Ag_2Se/MWCNTs	0.05 (300 K)	Solvothermal	9
Ag_2Se/MWCNTs	0.18 (300 K)	Solvothermal	10
Ag_2Se/RGO	0.39 (363 K)	Hydrothermal	11
Ag_2Se/MWCNTs/polyaniline	0.012 (300 K)	Chemical synthesis	12

MWCNTs: multiwalled carbon nanotubes, RGO: reduced graphene oxide

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