

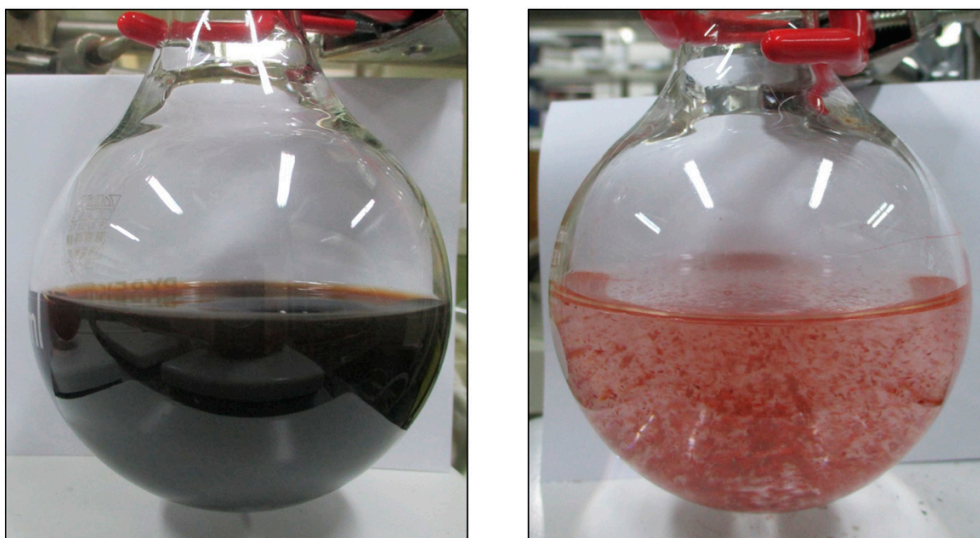
## Supporting Information

### **Synthesis and Thermoelectric Properties of Selenium Nanoparticles coated with PEDOT:PSS**

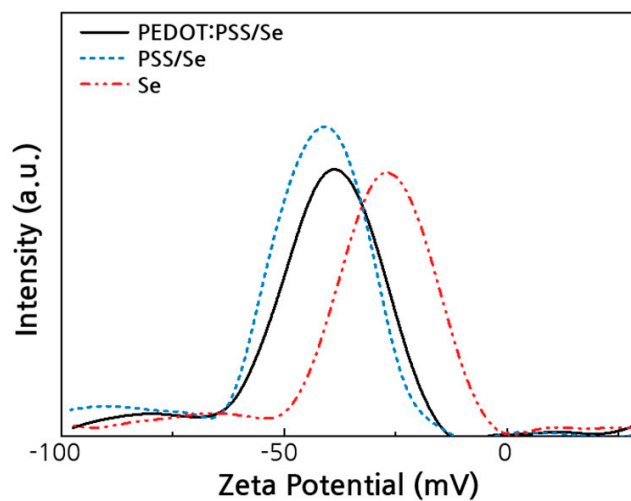
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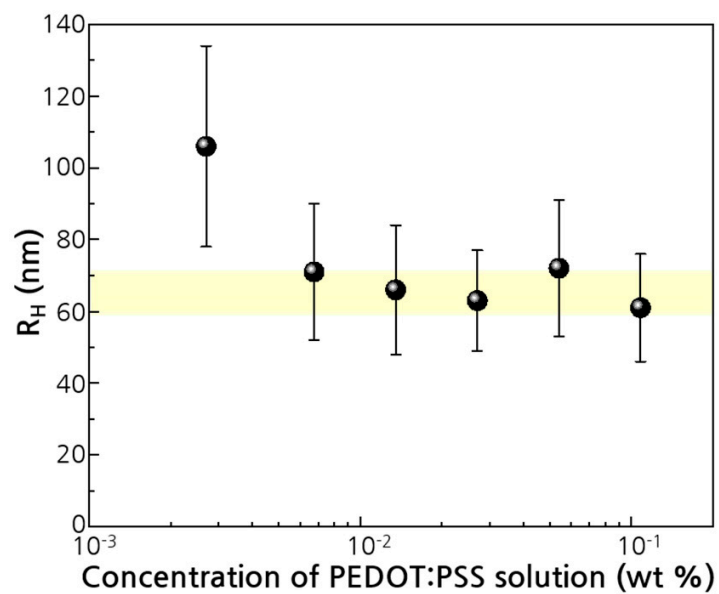
E-mail: [jiwoong@gist.ac.kr](mailto:jiwoong@gist.ac.kr)



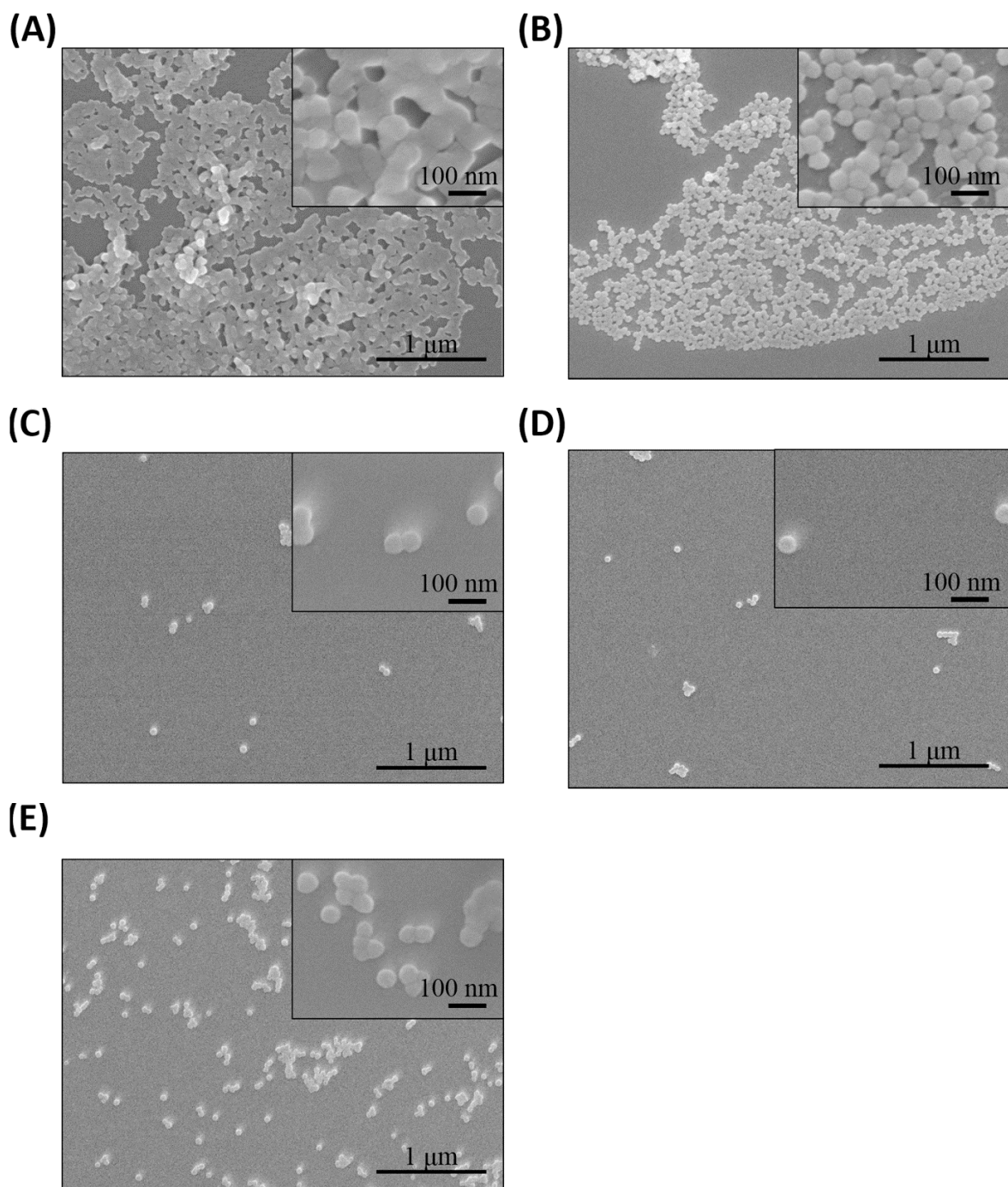
**Fig. S1.** Photographs of reaction mixtures with or without PEDOT:PSS (left and right, respectively).



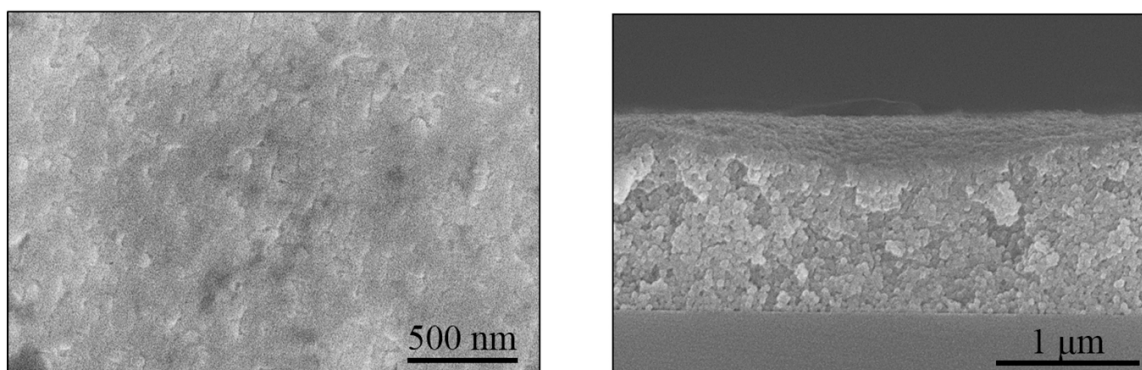
**Fig. S2.** Zeta potential distributions of PEDOT:PSS/Se, PSS/Se, Se particles dispersed aqueous solutions.



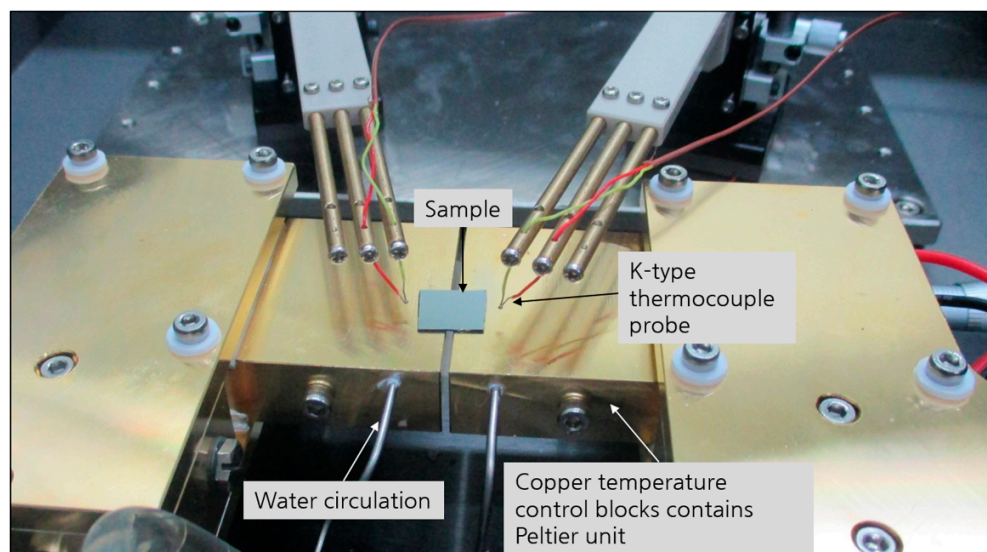
**Fig. S3.** Hydrodynamic radius of PEDOT:PSS/Se particles synthesized with different concentration of PEDOT:PSS solution. The yellow shade indicates the  $R_H$  from 60 to 70 nm.



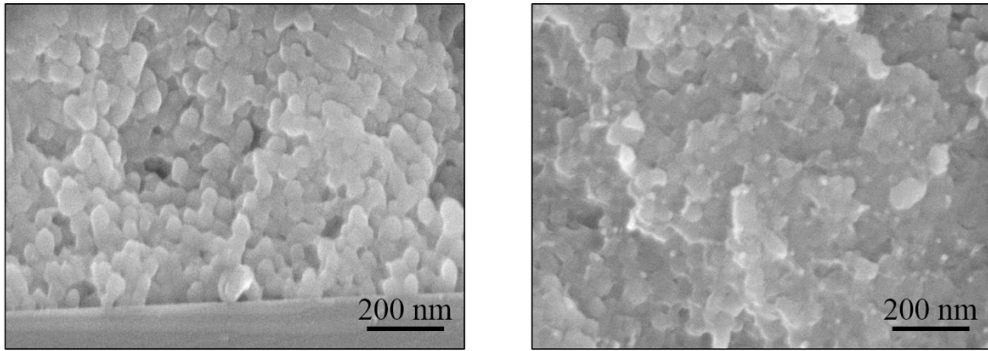
**Fig. S4.** SEM images of the PEDOT:PSS/Se particles synthesized with different concentration of PEDOT:PSS solution. (A)  $2.7 \times 10^{-3} \%$ . (B)  $6.75 \times 10^{-3} \%$ . (B)  $1.35 \times 10^{-2} \%$ . (B)  $5.4 \times 10^{-2} \%$ . (B)  $1.08 \times 10^{-1} \%$ .



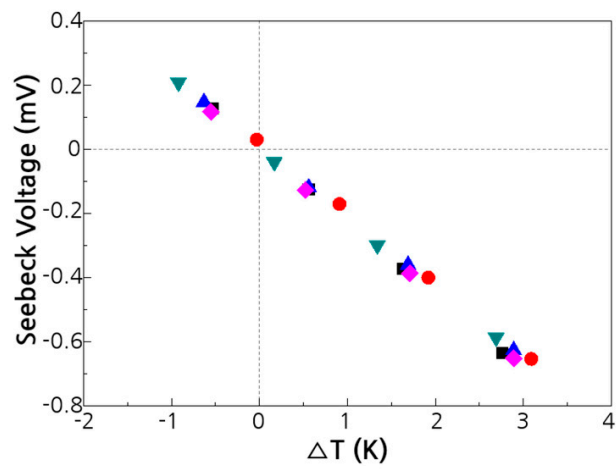
**Fig. S5.** SEM images of top surface (left) and cross-section (right) of PEDOT:PSS/Se film.



**Fig. S6.** Seebeck measurement set-up. Seebeck voltage was measured at different temperatures.



**Fig. S7.** SEM images of cross-sections of the composite films of about 4% (left) and 10% polymer compositions (right).



**Fig. S8.** Measurement of Seebeck voltage at different temperatures of a standard sample ( $\text{Bi}_2\text{Te}_3$  bar) five times.

**Table S1.** Polymer content estimated from elemental analysis of PEDOT:PSS/Se composite.

	C	H	O	S	Total
Measured (%)	1.99	-	-	0.87	
Estimated <sup>a</sup> (on C basis, %)	1.99	0.15	0.96	0.73	3.8
(on S basis, %)	2.39	0.18	1.16	0.87	4.6

<sup>a</sup> The calculation was made based on following assumptions. 1) The weight ratio of PEDOT/PSS (Clevios PH 1000, Heraeus) is 1/2.5. 2) Degree of sulfonation of PSS is 100 %.

**Table S2.** Room temperature thermoelectric properties of PEDOT:PSS/Se films which were thermally annealed at different temperatures.

Annealing Temperature (T) / °C	Electrical Conductivity ( $\sigma$ ) / S cm <sup>-1</sup>	Seebeck Coefficient (S) / $\mu$ V K <sup>-1</sup>	Power Factor (S <sup>2</sup> $\sigma$ ) / $\mu$ W cm <sup>-1</sup> K <sup>-2</sup>
No	0.37	45.5	9.5
70	0.27	43.4	5.1
100	0.37	43.5	7.0
120	0.71	44.5	15.0
150	0.49	45.2	10.0
200	0.14	40.7	2.3

**Table S3.** Room temperature thermoelectric properties of PEDOT:PSS/Se films with different thicknesses.

Average film thickness / $\mu$ m	Electrical Conductivity ( $\sigma$ ) / S cm <sup>-1</sup>	Seebeck Coefficient (S) / $\mu$ V K <sup>-1</sup>	Power Factor (S <sup>2</sup> $\sigma$ ) / $\mu$ W cm <sup>-1</sup> K <sup>-2</sup>
1.4	0.58	43.2	10.8
3.0	0.69	45.0	14.0
4.5	0.57	44.9	11.5