Supplementary Information

Modulation of the doping level of PEDOT:PSS film by treatment with hydrazine to improve the Seebeck coefficient

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Figure S1. (a) Average $\sigma$ and $S$ and (b) PF of the PEDOT:PSS films treated with different concentrations of formic acid with error bars. The formic acid concentration at 0 refers to the films without formic acid treatment i.e. pristine film. TE properties of the EG treated PEDOT:PSS films as a function of hydrazine weight concentration (c) $S$ and $\sigma$, and (d) PF. The hydrazine concentration at 0 refer to the films without hydrazine treatment, i.e. treated by EG only.
**Figure S2.** AFM height images: (a) pristine, (b) formic acid/0.2 wt% hydrazine treated and (c) formic acid/1 wt% hydrazine treated. AFM Phase images: (d) pristine, (e) formic acid/0.2 wt% hydrazine treated and (f) formic acid/1 wt% hydrazine treated. All images captured with an area of 1×1 μm².
Figure S3. XPS spectra of (a) 0.05 wt% hydrazine, (b) 0.1 wt% hydrazine and (c) 0.2 wt% hydrazine treated PEDOT:PSS films.
Figure S4. SEM images: (a) pristine, (b) formic acid 1 time treated (c) formic acid three times treated (d) formic acid-0.15wt% hydrazine pristine, (e) formic acid/ 2 wt % HZ treated and (f) EG/ 0.15 wt % HZ treated. All images captured an area of 1×1 μm².

Figure S5. (a) The pristine and (b) treated PEDOT:PSS films normalized thermal reflectance signals. The films coated with 100 nm-thick-Al after the nanosecond-pulse heating. The solid red lines represent the fitted temperature response curve that is used to extract the thermal effusivity of the PEDOT:PSS films and (c) The front heating, front detecting configuration used in the measurement text of the article should appear here with headings as appropriate.
Table S1. Treatment methods of some of PEDOT:PSS TE materials and their corresponding TE properties reported in the literature.

| Reference | Treatment methods | $\sigma$ (S/cm) | $S$ (µV/K) | $PF$ (µW/mK²) | $k$ (W/mK) | $ZT$ |
|-----------|-------------------|-----------------|------------|----------------|-------------|------|
| 1         | Post-treatment with DMSO/EG mixture | 952.8 | 19.0 | 37.1 | 0.17 | 0.065 |
| 2         | Dipping post-treatment H2SO4 | 1,167 | 12.1 | 17.0 | - | - |
| 3         | N,N-Dimethylformamide solution of Zinc chloride post treatment | 1400 | 26.1 | 98.2 | - | - |
| 4         | D-sorbitol addition , then vapor posttreatment with TDAE | 295 | 27.5 | 22.3 | | 0.01 |
| 5         | Urea addition | 63.1 | 20.7 | 2.7 | - | - |
| 6         | Formic acid post treatment | 1,900 | 20.6 | 80.6 | - | - |
| 7         | Treated with hydrazine | 578 | 67.0 | 112.0 | 0.37 | 0.093 |
| This work | Treated with formic acid and hydrazine | 513 | 42.7 | 93.5 | 0.30 | 0.10 |

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