Ultrafast Laser-induced excellent thermoelectric performance of PEDOT:PSS Films

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March 3, 2023

Abstract

Due to poly(3,4-ethylenedioxythiophene)-poly(styrenesulfonate) (PEDOT:PSS) is water-processable, thermally stable and highly conductive, PEDOT:PSS and its composites have been considered to be one of the most promising flexible thermoelectric materials. However, the PEDOT:PSS film prepared from its commercial aqueous dispersion usually has quite low conductivity, thus cannot be directly utilized for thermoelectric applications. Here, a simple environmentally friendly strategy via femtosecond laser irradiation without any chemical dopants and treatments was demonstrated. Under optimal conditions, the electrical conductivity of the treated film is increased to 803.1 S/cm from 1.2 S/cm around three order of magnitude higher, and the power factor is improved to 19.0 $\mu W \cdot m^{-1} \cdot K^{-2}$, which is enhanced more than 200 times. The mechanism for such remarkable enhancement was attributed to the transition of the PEDOT chains from a coil to a linear or expanded coil conformation, reduction of the interplanar stacking distance, and the removal of insulating PSS with increasing the oxidation level of PEDOT, facilitating the charge transportation. This work presents an effective route for fabricating high-performance flexible conductive polymer films and wearable thermoelectric devices.

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