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Enhancing the Thermoelectric Characteristics of PEDOT:PSS Through the Incorporation of a Redox-Active Small Molecule EDWARD TOMLINSON, MATTHEW WILLMORE, XIAOQIN ZHU, BRYAN BOUDOURIS, Purdue University — The polymer blend composed of poly(3,4-ethylene dioxythiophene) and poly(styrene sulfonate) (PEDOT:PSS) is a leading organic thermoelectric material due to its high-performing properties. Here, we establish the effect of incorporating the redox-active small molecule 4-hydroxy-2,2,6,6-tetramethylpiperidin-1-oxyl (TEMPO-OH) on the structural and thermoelectric properties of PEDOT:PSS. Specifically, the thermoelectric power factor (PF) was monitored as a function of TEMPO-OH loading, elucidating a clear trend in the PF. Importantly, at loadings as low as 5% TEMPO-OH, by mass, the thermopower of the sample was increased by a factor of two. Furthermore, the role of the TEMPO-OH on the thin film morphology of the composite material is examined through the use of grazing incidence-wide angle x-ray scattering (GI-WAXS) and atomic force microscopy (AFM). Despite the acidic conditions associated with the presence of PSS, the existence of radical functionality is confirmed through electron paramagnetic resonance (EPR) spectroscopy. Through careful tuning, the optimized conditions outlined within this work results in PF gains in excess of 40%.

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