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Thermoelectric thin hybrid films based on PEDOT:PSS and inorganic nanoparticles

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PEDOT:PSS is the most studied conducting polymer system owing to their intrinsically high electrical conductivity, low thermal conductivity, and high mechanical flexibility in thermoelectric devices. The energy conversion efficiency of a TE material is evaluated by a dimensionless figure of merit ZT and defined as ZT=S2σT/k where S is the Seebeck coefficient, σ is the electrical conductivity, T is the absolute temperature, k is the thermal conductivity, and S2σ is defined as the power factor. However, it is difficult to obtain a high ZT value, owing to the fact that the parameters S, σ, and k are interdependence as a function of carrier concentration and hard to be optimized simultaneously. To date, there are two promising approaches to significantly enhance ZT values of PEDOT:PSS. One is doping organic solvents. Another effective way to enhance the TE performance of PEDOT:PSS is to introduce inorganic nanomaterials with high TE property into conducting polymer matrix. Here, PEDOT:PSS thin films are nanostructured with inorganic nanoparticles and doped with organic solvents in order to optimize their TE performance. The surface and inner morphology are probed using scanning electron microscopy, atomic force microscopy and grazing-incidence wide/small-angle X-ray scattering, respectively. Additionally, UV-Vis spectroscopy, Raman spectroscopy and X-ray photoelectron spectroscopy are employed to investigate the mechanism behind for TE performance improvement.

Primary authors: TU, Suo (Institute of Functional Materials); MÜLLER-BUSCHBAUM, Peter (TU München, Physik-Department, LS Funktionelle Materialien)

Presenter: TU, Suo (Institute of Functional Materials)

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