Promising Thermoelectric Properties of Commercial PEDOT:PSS Materials and Their Bi₂Te₃ Powder Composites



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Newly commercialized PEDOT:PSS products CLEVIOS PH1000 and FE-T, among the most conducting of polymers, show unexpectedly higher Seebeck coefficients than older CLEVIOS Р products that were studied by other groups in the past, leading to promising thermoelectric (TE) power factors around 47 $\mu W/m$ K² and 30 $\mu W/m$ K² respectively. By incorporating both n and p type Bi₂Te₃ ball milled powders into these PEDOT:PSS products, power factor enhancements for both p and n polymer composite materials are achieved. The contact resistance between Bi₂Te₃ and PEDOT is identified as the limiting factor for further improvement. TE property These composites can be used for all-solution-processed TE devices on flexible substrates as a new fabrication option.

The figure at left shows the TE properties of the mixture of CLEVIOS PH1000 and n/p-type Bi_2Te_3 ball-milled powders. Bi_2Te_3 powders have a non uniform size distribution from sub-micron to several microns. The power factor of

the mixture using PH1000 is generally better than other products due to the best power factor associated with PH1000. The three highest power factors, 131, 113, and 119 μ W/m K², are respectively from the samples with 10 volume %, 17 volume % and 23 volume % of PEDOT. The general trend is that the electrical conductivity increased and Seebeck coefficient decreased with increase of PEDOT volume ratio. Note that an HCl rinsing process on the particles improved both Seebeck coefficient and electrical conductivity