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Conjugated polymer/layered inorganic nanocomposites: solution processable route to enhanced thermoelectric performance

KEVIN SEE, JEFFREY URBAN, The Molecular Foundry, Lawrence Berkeley National Lab, RACHEL SEGALMAN, Department of Chemical Engineering, University of California, Berkeley

— In recent years, incorporation of nanostructuring has led to notable improvements in the performance of thermoelectric materials. At a given temperature T, the thermoelectric figure of merit ZT is given by $\frac{S^2\sigma T}{\kappa}$, where S is the Seebeck coefficient, σ the electrical conductivity and κ the thermal conductivity. In most cases, improvement in ZT through nanostructuring has been realized via reduction in thermal conductivity κ rather than increases in the power factor $S^2\sigma$. Here we utilize solution-based intercalation chemistry to create layered inorganic/conjugated polymer nanocomposites with designed nanoscale interfaces engineered to enhance the power factor by energy filtering. The layered inorganic material Sb_2Te_3 was intercalated with poly(3-hexylthiophene), and the resulting composite material was cast into thin films from solution. The resulting devices exhibit Seebeck coefficients with two-fold enhancement over those reported for bulk $Sb_2Te_3$with known conductivities for solution-processed films. These results demonstrate the promise of these novel intercalated materials for high performance solution processable thermoelectric materials.

Kevin See
The Molecular Foundry, Lawrence Berkeley National Lab

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