Flexible Thermoelectric Fabrics Based on Layered Topological Insulator Bi$_2$Se$_3$ Nanoplates/Polyvinylidene Fluoride Composite

CHAOCHAO DUN, COREY HEWITT, HUIHUI HUANG, DAVID CARROLL, Center for Nanotechnology and Molecular Materials, Department of Physics, Wake Forest University, Winston-Salem, NC 27109, U. S — We report a highly-flexible and ultrathin thermoelectric fabrics based on topological insulator (TI) Bi$_2$Se$_3$ Nanoplates/PVDF Composite, which show a room temperature Seebeck coefficient, electrical conductivity, and figure of merit ZT ~8 μV/K, 5000 S/m, 0.02, respectively. This results demonstrate that Bi$_2$Se$_3$ Nanoplates/PVDF composite exhibit favorable thermoelectric characteristics, which opens a new avenue to fabricate highly-flexible and lightweight sustainable energy sources that could be compatible with portable/wearable electronic devices. The low thermal conductivity of the composites (~ 0.42 W/(mK)) suggests the nonconducting host polymer matrix PVDF serves to bind the conducting topological insulator (TI) Bi$_2$Se$_3$ while still maintaining an adequate power factor and figure of merit. The flexible thermoelectric fabrics based on layered topological insulator Bi$_2$Se$_3$ Nanoplates/PVDF composite that with comparable thermoelectrical efficiency is only a typical example that showing the promising of the present method for further applications of 2D topological insulator like Bi$_2$Se$_3$, Bi$_2$Te$_3$ and Sb$_2$Te$_3$ At their current performance, if enough thermal energy is available, the composites could be used to provide sufficient thermoelectric power for low powered personal and portable electronics.

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