Semi-metallic polymers

Polymers are lightweight, flexible, solution-processable materials that are promising for low-cost printed electronics as well as for mass-produced and large-area applications. Previous studies demonstrated that they can possess insulating, semiconducting or metallic properties; here we report that polymers can also be semi-metallic. Semi-metals, exemplified by bismuth, graphite and telluride alloys, have no energy bandgap and a very low density of states at the Fermi level. Furthermore, they typically have a higher Seebeck coefficient and lower thermal conductivities compared with metals, thus being suitable for thermoelectric applications. We measure the thermoelectric properties of various poly(3,4-ethylenedioxythiophene) samples, and observe a marked increase in the Seebeck coefficient when the electrical conductivity is enhanced through molecular organization. This initiates the transition from a Fermi glass to a semi-metal. The high Seebeck value, the metallic conductivity at room temperature and the absence of unpaired electron spins makes polymer semi-metals attractive for thermoelectrics and spintronics.

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