Giant Seebeck Coefficient in V-TCNE thin films

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The disordered structure of organic conductors results in a naturally low thermal conductivity ($\kappa$) but their ZT is known to be low because of their low thermopower ($S$) and electrical conductivity ($\sigma$). Here we report an exception, with results obtained from 220 to 320K for the thermopower of V-TCNE$_x$ ($V$-(C$_2$(CN)$_4$)$_x$) thin films deposited on a Si wafer (111). At room temperature $S=+21.8$ mV/K and increases with decreasing temperature. Those values are matched only by very pure semiconductors such as Si at low temperature, Bi nanowires, or strongly correlated electron systems like FeSb$_2$. The valence band of V-TCNE has a very high density of states over a very narrow energy range, ascribed mostly to vanadium 3d($t_{2g}$) orbitals, which is consistent with the exceptionally large value of $S$. The dependence of $S$ and $\sigma$ upon illumination will also be shown, alongside preliminary estimates for the ZT.

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2Y-J Yoo et al., Nat. Mat. 9 638 2010

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