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Field-effect modulated Seebeck coefficient in pentacene and rubrene K.P. PERNSTICH, B. ROESSNER, B. BATLOGG, Laboratory for Solid State Physics, ETH Zurich, 8093 Zurich, Switzerland — We report on the first study of the charge carrier concentration and the temperature dependence of the Seebeck coefficient S for two prototypical organic semiconductors measured in a field-effect transistor (FET) structure. As a basic transport property of solids, the Seebeck coefficient provides deep insights into the nature and dynamics of charge carriers. Using a FET structure enables the variation of the Fermi-level position in the active semiconductor region while measuring S, which is essential for determining individual contributions to the thermopower. The sign of the measured Seebeck coefficient is consistent with hole transport, and S is in the range of 0.3-1 mV/K, it is independent of temperature between 295 K and 200 K, and interestingly it decreases for both semiconductors as $S \propto |V_g|$. The measured S is quantitatively described by $S = (k/e)(E(V_g)/kT + A)$. The Fermi-level position $E(V_g)$ is obtained from analyzing the transistor's characteristic which then allows to calculate the parameter A. For both semiconductors we find that A is in the range of 1.7-3.6, just as in conventional semiconductors. The results are well described by solely considering a realistic density of in-gap trap states and band-like transport of quasiparticles that are subjected to scattering. There is no need to invoke self-trapping of massive charge carriers.

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