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Carrier coherence and high-resolution Hall effect measurements in organic semiconductors.[1]

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Charge conduction in organic semiconductors frequently occurs in a regime at the borderline between a band-like coherent motion of delocalazied carriers in extended states and an incoherent hopping through localized states. Many intrinsic factors are competing for defining the dominant transport mechanism, including the strength of intermolecular interactions represented by the transfer integrals, carrier self-localization due to formation of polarons, electron-phonon coupling, scattering and off-diagonal thermal disorder (see, e.g., [1]). Depending on the interplay between these processes, either band-like or hopping charge transport realizes. Besides these intrinsic factors, a significant role in practical devices is played by the static disorder (chemical impurities and structural defects) that leads to carrier trapping at various energies and time scales. In most of these cases, the charge carrier mobility in OFETs is rather small (0.1 - 20 $cm^2V^{-1}s^{-1}$) [], and in order to carefully and accurately characterize it, Hall effect measurements are necessary. Conventional Hall measurements are extremely challenging in systems with such low mobilities. Here, we present a novel Hall measurement technique that can be carried out in low magnetic fields with an amazing sensitivity, much greater than that attained in conventional Hall measurements [2]. We apply this method to mobility measurements in a variety of OFETs with mobility as low as ˜0.3 $cm^2V^{-1}s^{-1}$ [2] and reveal various peculiarities of Hall effect in low-mobility systems. By taking advantage of this powerful new experimental capability, we have understood several "mysteries" of Hall effect observed by various groups in OFETs over the last decade [3]. REFERENCES: [1]. V. Podzorov, "Organic single crystals - addressing the fundamentals of organic electronics". *MRS Bulletin* **38**, 15-24 (2013). [2]. Y. Chen, H. T. Yi and V. Podzorov, "High-Resolution ac Measurements of the Hall Effect in Organic Field-Effect Transistors", *Phys. Rev. Applied* **5**, 034008 (2016). [3]. H. T. Yi, Y. N. Gartstein and V. Podzorov, "Charge carrier coherence and Hall effect in organic semiconductors", *Sci. Reports*, srep23650 (2016).

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