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Electrically detected magnetic resonance in organic light emitting diodes[1]

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Due to the built-in weak spin-orbit coupling of carbon based materials, electronic transitions in organic semiconductors are subjected to strong spin-selection rules that are responsible for a number of interesting electron spin- and even nuclear spin-dependent electrical and optical properties of these materials, including device efficiencies of organic light emitting diodes and solar cells or magnetoresistive and magneto-optic effects. In recent years, we have studied how these effects work and how they can be utilized for organic semiconductor device improvement and new device applications. Our focus has been in particular on the effects of spin on π-conjugated polymer based bipolar injection devices (more commonly known as organic light emitting diodes, OLEDs). In OLEDs, spin-interactions between recombining charge carriers do not only control electroluminescence rates but also the magnetoresistance. We have shown that spin-coherence can be observed through current measurements [1] and that these effects can be utilized for a coherent, pulsed electrically detected magnetic resonance spectroscopy (pEDMR) which enables us to encode the qualitative nature of spin-dependent mechanisms (the polaron pair mechanism [2,3] and the triplet polaron recombination [4]) and the their dynamical nature (spin-relaxation, electronic relaxation, hopping times [5]). The insights gained from these studies have led to the invention of a robust absolute magnetic field sensor based on organic thin film materials with absolute sensitivities of $<50\text{nT/Hz}^{1/2}$ [6].

[1] D. R. McCamey, et al., Nature Materials, 7, 723 (2008).
[2] D. R. McCamey, et al., Phys. Rev. Lett. 104, 017601 (2010).
[3] S.-Y. Lee, et al., J. Am. Chem. Soc. 133, 072019 (2011).
[4] Baker et al., Phys. Rev. B 84, 165205 (2011).
[5] Baker et al., Phys. Rev. Lett. 108, 267601 (2012). [6] Baker et al., Nature Communications 3, 898 (2012).

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