MAR11-2010-001613

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

Coherent spin spectroscopy in organic thin film semiconductor devices[1]

CHRISTOPH BOEHME, University of Utah, Department of Physics and Astronomy

With the emergence of organic spintronics and renewed interest in magnetoresistive effects, there is much need to illuminate the properties of spins in molecular electronic materials. Examples include spin-relaxation times, spectral diffusion times, spin dephasing times and spin interactions. In this presentation, an overview is given about the concepts of pulsed, electrically and optically detected magnetic resonance spectroscopy as techniques to manipulate and observe and thus characterize these fundamental properties of electron and nuclear spins in organic semiconductors [1]. By coherent (pulsed) magnetic resonant perturbation of spin states one may cause the spins to coherently propagate in a defined manner [2]. Spin-dependent charge carrier-transport or -recombination allow the observation of this coherent spin motion through electrical or optical measurements in working devices, such as organic light-emitting diodes. The ubiquitous presence of hydrogen nuclei gives rise to strong hyperfine interactions, which appear to provide the basis for many of the magnetoresistive effects observed in these materials. Since hyperfine coupling influences resonantly driven quantum spin beating in electrically or optically detectable electron-hole pairs, an extraordinarily sensitive probe for hyperfine fields in such pairs is given [3]. This allows scrutinizing the various existing models for these electronic processes. Qualitative as much as quantitative insights are gained into some of the physical intricacies of organic semiconductor device fabrication such as the influence of contact materials on spin-orbit coupling.

[1] D. R. McCamey, et al. Nature Mat. 7, 723, (2008).
[2] C. Boehme et al. Phys. Stat. Sol B. 246, 11-12, 2750 (2009).
[3] D. R. McCamey, et al. Phys. Rev. Lett. 104, 017601 (2010).

[1]Acknowledgment is made to the US Department of Energy, Office of Science (grant #DESC0000909) and the National Science Foundation (grant #0953225).