DETERMINING THE CRUCIAL PARAMETERS FOR MAGNETORESISTANCE EFFECTS IN ORGANIC SEMICONDUCTORS USING MULTI-FREQUENCY ELECTRICALLY DETECTED MAGNETIC RESONANCE SPECTROSCOPY IN THE VERY-LOW TO VERY-HIGH MAGNETIC FIELD RANGE

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Magneto-opto-electronic properties of organic semiconductors, such as organic magnetoresistance or magneto-electroluminescence, are strongly influenced by the interplay of proton induced hyperfine fields to which charge carrier spins are coupled[1-3]. In addition, the weak but non-negligible and highly inhomogeneously distributed spin-orbit effects caused by the material's structural disorder can affect spin-dependent processes[4].

In order to quantitatively access and discriminate between both coupling mechanisms, we have investigated the inhomogeneous broadening of charge-carrier pair spin-resonances using electrically detected magnetic resonance (EDMR) spectroscopy at various magnetic fields between approximately 3mT and 12T using RF coils for low magnetic fields, capacitively coupled planar micro-resonators for the magnetic field range of 30mT < B < 800mT, and the quasi-optical super-heterodyne mm-wave spectrometer at the National High Magnetic Field Laboratory for magnetic fields above 4T.

While random local hyperfine fields cause a line broadening independent of the external magnetic field, spin-orbit contributions give rise to a distribution of the charge carrier's g-factors. This so-called Δg-effect leads to a resonance line-width contribution that is proportional to the external magnetic field. We observe an EDMR line that is largely field-independent in the low-magnetic field regime, but shows substantial broadening and line shape changes at higher fields. Using a numerical model that takes the field-dependence of the line shape into account, we can determine the magnitude of hyperfine and spin-orbit effects.

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