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Isotope Effect in Organic Magneto-Transport; the Role of Hyperfine Interaction[1]

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Organic semiconductors have been used as active layer in devices such as organic light-emitting diodes, photovoltaic cells, and field-effect transistors. Recently there has been a growing interest in spin and magnetic field effects (MFE) in these materials. This include optically detected magnetic resonance (ODMR), where long spin coherence time was demonstrated; organic light emitting diodes (OLED), where substantive magneto-electroluminescence and magneto-conductance were obtained; and organic spin valves (OSV), where spin injection from ferromagnetic electrodes was verified. The interest in organic semiconductors has been motivated by the weak spin-orbit interaction that is caused by the light building block elements such as carbon and hydrogen. However, the role of the hyperfine interaction (HFI) between the injected spin-$1/2$ carriers and various nuclear spins in organic magneto-transport has not been experimentally tested. Using the chemical versatility advantage of the organics, we studied and compare the magnetic-field effects in films, OLED and OSV devices based on polymers made of protonated, H-, and deuterated, D-hydrogen having a weaker HFI strength. We demonstrate that the HFI indeed plays a *crucial role* in all three magnetic-field effects. OLEDs [films] based on the D-polymers show substantial narrower MFE [ODMR] response; whereas due to the longer measured spin diffusion, OSV devices based on D-polymers show substantially larger magnetoresistance response.

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