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Spin Transport in Organic Semiconductors

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Spin injection/detection and coherent transport are necessary ingredients in spin electronics or spintronics. Organic semiconductors are believed to have long spin coherence due to the weak spin-orbit interaction and hyperfine interaction; therefore, may be useful in spintronic device applications. Recently, we have successfully achieved electrical spin injection/detection and demonstrated coherent spin transport in spin valve devices using an organic semiconductor spacer. The devices consist of LSMO and Co ferromagnetic electrodes and small molecule material Alq3 spacer. A large inverse spin valve magnetoresistance (up to 40%) was observed in these devices, which entails coherent spin transport in organic semiconductors. In addition to the spin valve magnetoresistance effect at low fields, we have also found magnetoresistance and magneto-eletroluminescence at high magnetic fields. This latter high-field effect is due to the field-dependent carrier injection at the ferromagnetic/organic interfaces. It is the first experimental evidence of the anomalous chemical potential shift theoretically predicted for double exchange ferromagnets such as LSMO. In collaboration with Z.H. Xiong, D. Wu, and Z.V. Vardeny; work supported by DARPA, NSF, and DOE.