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Origin of magnetoresistance in organic spin-injection structures ZHI-GANG YU, SRI International — Spin injection into organic materials is usually inferred from the device resistance difference between antiparallel and parallel magnetic configurations (magnetoresistance, or MR) in an organic spin valve (OSV). The common features of the observed MR in OSVs include: 1) the MR is pronounced only at a low bias, where the device I-V characteristic is essentially linear; 2) the MR quickly decreases with bias and temperature while the decrease in device resistance is insignificant; 3) the MR is usually negative for OSVs with thick organic films, particularly when the two ferromagnets are similar in electronic structure. Despite superficial resemblance between OSVs and inorganic spin-injection structures, the MR in the former cannot be explained by theories developed for the latter. Here we show that the resistance of an OSV is controlled by the carrier density deep inside the organic and the MR is due to the difference in the carrier density for the two magnetic configurations. The sign of MR is determined by the electron spin polarization at a finite energy above the Fermi level in the electrodes. This picture explains common features of MR and suggests new strategies for probing and manipulating spin in organic spintronic structures.

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