Room temperature magnetoresistance effect in organic spin valves

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One of the important goals of studying OSVs extensively is to obtain large MR at room temperature.
MR decreased steeply with increasing T and vanished at room temperature. The authors originally attributed the MR reduction to the reduction of spin diffusion length since the temperature dependence of magnetization of LSMO measured by MOKE is much weaker than that of the MR while the magnetization of Co is almost constant.
Spin diffusion length

The spin diffusion length of the OSCs decreases with increasing $T$.

$$\Delta R \times R = \frac{R_{AP} - R_p}{R_{AP}} = \frac{2p_1p_2e^{-(d-d_0)/\lambda_s}}{1 + p_1p_2e^{-(d-d_0)/\lambda_s}}$$

A direct measurement of spin diffusion length of Alq$_3$ using LE-μSR and its correlation with temperature dependent MR

_Synth. Met._ 2013, **173**, 26

_Nat. Mater._ 2009, **8**, 109
The magnetization and hence the spin polarization at the surface decreases much faster with \( T \) and vanishes at Curie temperature \( T_C \), and in relation to this study, the temperature dependence of MR measured by many groups were shown to mainly correspond to the temperature dependence of the surface polarization.
The first room temperature MR of about 1.5% on the LSMO/region-regular (poly3-hexylthiophene) (RRP3HT)(100 nm)/Co OSVs with 100 nm was observed by annealing the organic film before the top electrode evaporation.
Interfacial Al2O3 improved MR

A TMR ~5% at room temperature was obtained in Co/Al2O3/Alq3 (<2 nm)/NiFe magnetic tunnel junction. The inclusion of Al2O3 in between Co and Alq3 layer did play the role in energy level alignment of the ferromagnetic electrode/interface.

*Phys. Rev. Lett.* 2007, **98**, 016601
Interfacial Al2O3

weak temperature dependent spin diffusion length

Sci. Rep. 2015, 5, 9355
RT MR in C60 based OSVs

Significant room temperature MR values (in excess of 5%) on C₆₀-based vertical spin valves with different thickness of the C₆₀ interlayer (from 5 nm to 28 nm) up to high applied biases (~1 V).

Adv. Mater. 2011, 23, 1609
Heusler alloy based OSVs

In this TPD-based OSV (200 nm thickness), Co$_2$MnSi Heusler alloy with large Curie temperature ensures a large spin injection at room temperature and nearly 10% MR in it.

Org. Electron. 2013, 14, 3186