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Using muons as microscopic spin probes for organic devices

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One future avenue that may expand the rapidly growing spintronic technology is to take advantage of the long spin coherence time and of the flexibility of organic semiconductors [1]. However, advancements in understanding the behaviour of hybrid organic/inorganic spintronic devices have been slowed down by the lack of experimental techniques able to directly measure the polarization of injected carriers in operational devices.
We show how it is possible to use low energy muon spin rotation (LEM) to obtain a direct and depth-resolved measurement of the spin polarization of the injected charge-carriers in a fully functional organic spin valve. Muons act as local magnetic probes, directly measuring the magnetic field distribution at the implanted site. By measuring the local magnetic field with current on and current off it is possible to extract the contribution of the spin-polarized current. Using different implantation energies finally allows to obtain the depth-resolution [2]. Using LEM we were able to prove, for example, that it is possible to control the spin polarization of extracted charge-carriers from an OSC by the inclusion of a thin interfacial layer of polar material [3].

References
[1] I. Bergenti et al., Org. Electron. 5, 309 (2004) [2] A.J. Drew et al., Nature Mater. 8, 109 (2009) [3] L. Schulz et al., Nature Mater. 10, 39 (2010)

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