

Voltage-controlled on/off magnetism of $\text{La}_{1-x}\text{Sr}_x\text{MnO}_3$ using an ionic liquid

Alan Molinari¹, Robert Kruk¹, Horst Hahn¹

¹Institute of Nanotechnology (INT), Karlsruhe Institute of Technology (KIT), Hermann-von-Helmholtz-Platz 1, 76344, Eggenstein-Leopoldshafen, Germany

The control of magnetism by application of an external voltage, based on the phenomenon of magnetoelectric (ME) effect, offers a promising route towards the realization of novel low-power microelectronic and spintronic devices. In our studies we have investigated the ME coupling in thin [1] (about 13 nm) and ultrathin [2] (about 3 nm) films of $\text{La}_{1-x}\text{Sr}_x\text{MnO}_3$ (LSMO) gated with an ionic liquid (IL) electrolyte. The analysis of the LSMO magnetic response upon voltage-driven charge carrier doping was carried out by combining *in situ* Superconducting Quantum Interference Device magnetometry and Cyclic Voltammetry. The large amounts of surface charge densities induced with the IL allowed to robustly and reversibly tune ferromagnetism in LSMO by application of just a few volts. In addition, in case of ultrathin films of LSMO, the increased surface-to-volume ratio of the LSMO/IL devices enabled the complete suppression and recovery of the LSMO magnetization.

References

[1] A. Molinari *et al.*, **Nat. Comm.** 8, 15339 (2017), doi: 10.1038/ncomms15339

[2] A. Molinari *et al.*, **Adv. Mater.** 1703908 (2017), doi: 10.1002/adma.201703908