MAR16-2015-002688

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Electrical switching of an antiferromagnet[1]

TOMAS JUNGWIRTH, Institute of Physics, Academy of Sciences of the Czech Republic and University of Nottingham UK

Louis Néel pointed out in his Nobel lecture that while abundant and interesting from theoretical viewpoint, antiferromagnets did not seem to have any applications. Indeed, the alternating directions of magnetic moments on individual atoms and the resulting zero net magnetization make antiferromagnets hard to control by tools common in ferromagnets. Strong coupling would be achieved if the externally generated field had a sign alternating on the scale of a lattice constant at which moments alternate in AFMs. However, generating such a field has been regarded unfeasible, hindering the research and applications of these abundant magnetic materials. We have recently predicted that relativistic quantum mechanics may offer staggered current induced fields with the sign alternating within the magnetic unit cell which can facilitate a reversible switching of an antiferromagnet by applying electrical currents with comparable efficiency to ferromagnets. Among suitable materials is a high Nel temperature antiferromagnet, tetragonal-phase CuMnAs, which we have recently synthesized in the form of single-crystal epilayers structurally compatible with common semiconductors. We demonstrate electrical writing and read-out, combined with the insensitivity to magnetic field perturbations, in a proof-of-concept antiferromagnetic memory device. References: [1] J. Zelezny, et al., Phys. Rev. Lett. 113, 157201 (2014). [2] P. Wadley, et al., Nat. Commun. 4, 2322 (2013). [3] P. Wadley et al. http://arxiv.org/abs/1503.03765. [4] T. Jungwirth, X. Marti, P. Wadley, J. Wunderlich, http://arxiv.org/abs/1509.05296.

[1]We acknowledge support from European Research Council Advanced Grant no. 268066