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Electrical characterization of spin-charge conversion in nanodevices of SrTiO3 two-dimensional electron gases

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Spin-orbitronics is a wide field that takes advantage of the effect of spin-orbit coupling (SOC) on the spintronic response of materials. SOC is the responsible for the spin-charge interconversion through effects such as Edelstein effect, which occurs naturally in topological insulators and Rashba systems. One recently proposed spin-orbitronic device is the Magnetoelectric Spin-Orbit (MESO) technology that brings logic into memory by combining a ferromagnet with a magnetoelectric (ME) element for information writing and a SOC element for information read-out [1-3]. Key to the operation of MESO is to use a SOC system able to generate a large output voltage (up to 100 mV). Among candidate materials, oxide 2DEGs have shown very large spin-charge conversion efficiency but only in spin-pumping experiments and at low T [4,5]. Here we report all-electrical spin-injection and spin-charge conversion experiments in nanoscale devices harnessing the inverse Edelstein effect of STO Rashba 2DEGs. We have designed, patterned and fabricated T-shaped nanodevices where a spin current is injected from a cobalt layer into the 2DEG and is converted into a charge current. By taking advantage of the large tunability of the electronic structure of 2DEGs, we optimized the spin-charge conversion signal by applying back-gate voltages and studied its temperature evolution. We further disentangled the inverse Edelstein contribution from numerous spurious effects, namely planar Hall effect, anomalous Hall effect or anisotropic magnetoresistance [6]. We found encouraging results in terms of future applications for alternative computing approaches based on spin logic. The combination of non-volatility and high energy efficiency of these devices could potentially lead the new technology paradigm in beyond-CMOS computing devices.

[1] S. Manipatruni et al., "Scalable energy-efficient magnetoelectric spin–orbit logic,"Nature, vol. 565, no. 7737, pp. 35–42, Jan. 2019, doi: 10.1038/s41586-018-0770-2.
[2] A. Manchon, H. C. Koo, J. Nitta, S. M. Frolov, and R. A. Duine, "New perspectives for Rashba spin-orbit coupling,"Nature Materials, vol. 14, no. 9, pp. 871–882, Aug. 2015, doi: 10.1038/nmat4360.
[3] M. Bibes and A. Barthélémy, "Towards a magnetoelectric memory,"Nature Materials, vol. 7, no. 6, pp. 425–426, Jun. 2008, doi: 10.1038/nmat2189.
[4] E. Lesne et al., "Highly efficient and tunable spin-to-charge conversion through Rashba coupling at oxide interfaces,"Nature Materials, vol. 15, no. 12, pp. 1261–1266, Dec. 2016, doi: 10.1038/nmat4726.
[5] D. C. Vaz et al., "Mapping spin–charge conversion to the band structure in a topological oxide two-dimensional electron gas,"Nature Materials, vol. 18, no. 11, pp. 1187–1193, Nov. 2019, doi: 10.1038/s41563-019-0467-4.
[6] V. T. Pham et al., "Spin–orbit magnetic state readout in scaled ferromagnetic/heavy metal nanostructures," Nature Electronics, vol. 3, no. 6, pp. 309–315, Jun. 2020, doi: 10.1038/s41928-020-0395-y.

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