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# Thermo-spin effects in multifunctional materials and 2D interfaces for spin-to-charge current interconversion

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*The search for ferromagnetic insulating materials with multifunctional properties is currently a highly sought after objective in spintronics. In current spintronics, functional devices are typically made of a bilayer composed of a material with large spin-orbit coupling (NM) and a ferromagnet (FM). These type of devices allow functionalities like the manipulation of the FM magnetization by the spin Hall effect (SHE)[1] in the NM or energy harvesting by means of its inverse counterpart, the inverse spin Hall effect.[2] Insulating ferrimagnets are preferred for this purpose to pave the way towards low dissipation spintronics devices.[3] Additional functionalities, like the possibility of the electric field control of the magnetic properties of such systems, could be given to these heterostructures through the introduction of multifunctional ferromagnets opening the possibility of having more efficient and versatile devices.[4]*

*In this regard, we have studied the thermo-spin current generation in bilayers composed of Pt and the multifunctional magnetoelectric $Ga_{0.6}Fe_{1.4}O_3$ (GFO). We compare the performance of this new system with the widely used yttrium iron garnet obtaining a similar value of the spin Seebeck effect.[5]*

*Another approach to obtain more efficient devices based on thermo-spin phenomena is taking advantage of the role of interfaces and 2D materials. It is possible to exploit the properties of these structures to obtain new functionality in spin caloritronics. Here, we explore the effect of a graphene monolayer between a FM and a NM layers in a fully-epitaxial system and its interfacial spin transport properties by means of thermo-spin measurements.[6]*



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3. Avci, C. O. et al. Nature 461, 1218–1219. (2009).
4. Roy, A. et al. Ferroelectrics 473, 154–170. (2014).
5. Anadón, et al. Physical Review Applied, 18(5), 054087 (2022).
6. Anadón, et al. APL Materials, 9(6), 061113. (2021).



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