Pure spin current transmission in Nonmagnetic/Antiferromagnetic/Ferromagnetic (NM/AF/FM) heterostructures

S. Chen[1], A. Pomar[1], Ll. Balcells[1] , C. Frontera[1] , Z. Konstantinovic[2] , N. Mestres[1] and B. Martínez[1]
[1] Instituto de Ciencia de Materiales de Barcelona. ICMAB-CSIC. Bellaterra 08193. Spain
[2]Center for Solid State Physics and New Materials, Institute of Physics Belgrade, University of Belgrade, Serbia

cschoulong@icmab.es

Abstract

The development of next-generation spintronic devices requires achieving efficient spin current injection alongside a high spin-charge interconversion efficiency. Thus far, impedance matching and spin−orbit coupling have stood out as crucial factors in spin current transport within ferromagnetic and nonmagnetic (FM/NM) heterostructures. Well-engineered interfaces have shown promise in facilitating effective spin transfer. Recently, the integration of antiferromagnets (AF) has garnered significant interest, not only due to potential implications on interface properties but also because of the emergence of magnon-mediated spin currents capable of traversing both conducting and insulating FMs and AFs. Notably, robust spin transport has been observed in the AF insulator NiO. However, the underlying mechanisms governing spin transport in AF insulators remain unclear, particularly regarding the role of the AF's crystalline nature (polycrystalline or epitaxial).

Herein, we present our findings on the inverse spin Hall effect (ISHE) in La1-xSrxMnO3/NiO/Pt heterostructures, examining the influence of the antiferromagnetic NiO layer thickness. Our samples were grown via rf sputtering and characterized using advanced X-ray diffraction techniques. We delve into the impact of interfacial quality on spin propagation throughout the heterostructure, shedding light on the relevance of NiO thickness in this context.

The authors acknowledge financial support from the Spanish Ministry of Science and Innovation through Severo Ochoa (CEX2019-000917-S) and OXISOT (PID2021-128410OBI00) and Serbian Ministry of Education, Science and Technological Development.

Figures

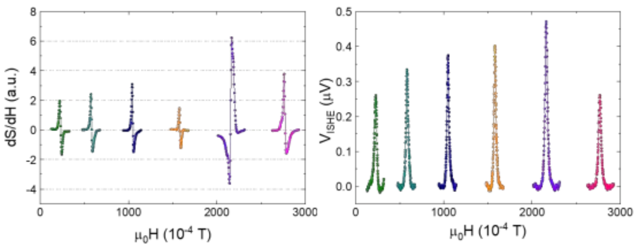

Figure 1. (left) Ferromagnetic resonance and (right) Inverse Spin Hall Effect measured in a LSMO(15nm)/NiO(1nm)/Pt (5nm) heteroestructure at 300K. Measured frequencies are 3, 5, 7, 9, 11 and 13 GHz.