

On-line SPICE-SPIN+X Seminars



Wednesday, 16th June 2021, 15:00 (German Time)

The seminar will be via Zoom ([Meeting ID: 849 9892 2655](#)) and live streamed in the SPICE YouTube Channel.



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Electrical Generation of Spin Currents

Spin currents in magnetic random access memory (MRAM) devices being developed by the semiconductor industry are generated by passing an electrical current perpendicular to layers that form a magnetic tunnel junction [1]. However, it is now widely appreciated that current flow in the plane of a layer can generate significant spin currents through spin-orbit coupling, as first reported in heavy non-magnetic metal layers (e.g. Pt, Ta & W). In this case, however, the spin polarization is generally confined to the plane of the layers. An important research goal is to create a spin current with an arbitrary polarization, including one with a significant out-of-plane spin polarization to enable efficient switching and displacement of domain walls in perpendicularly magnetized layers. In this talk we discuss spin-orbit induced charge-to-spin conversion in various materials and nanostructures [2] and with magnetic materials. Specifically, we will report our observation of spin torques with a planar Hall effect symmetry from CoNi, with a spin polarization in the magnetization direction of the layer [3]. We found the strength of this effect to be comparable to that of the spin Hall effect in Pt, indicating that the planar Hall effect in ferromagnetic metals holds great promise as a spin current source with a controllable spin polarization direction.

[1] A. D. Kent and D. C. Worledge, *Nature Nanotechnology* 10, 187 (2015)

[2] J-W. Xu and A. D. Kent, *Physical Review Applied* 14, 014012 (2020)

[3] C. Safranski, J. Z. Sun, J-W., Xu and A. D. Kent, *Physical Review Letters* 124, 197204 (2020)