

Efficient Finite Element Method Approach to Model Spin Orbit Torque MRAM

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Abstract:

Finite element method (FEM) based approach to evaluate spin and charge currents has been successfully applied to simulate spin transfer torques (STT) in spin valves and magnetic tunnel junctions [1]. The capabilities of the simulator are now further extended to include the spin Hall effect (SHE) responsible for spin-orbit torques (SOT). Based on a weak formulation, the corresponding transport terms are derived, implemented, and integrating into the FEM simulator. The spin accumulation and the SOT due to the SHE are successfully reproduced in a non-magnetic/ferro-magnetic bi-layer. Versatile and reliable FEM-based simulation software will be essential for further accelerating the development and optimization of SOT MRAM.

References

- [1] S. Fiorentini *et al.*, “Comprehensive Modeling of Coupled Spin-Charge Transport and Magnetization Dynamics in STT-MRAM Cells,” *Proceedings of SPIE*, vol. 11470, pp. 50–56, 2020, invited. DOI: 10.1117/12.2567480. [Online]. Available: https://www.iue.tuwien.ac.at/pdf/ib_2020/JB2020_Fiorentini_1.pdf.