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SPICE based compact model for electrical switching of antiferromagnet

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ABSTRACT

A simulation framework that can model the behavior of antiferromagnets (AFMs) is essential to building novel high-speed devices. The electrical switching of AFMs allows for high performance memory applications. With new phenomena in spintronics being discovered, there is a need for flexible and expandable models. With that in mind, we developed a model for AFMs which can be used to simulate AFM switching behavior in SPICE. This approach can be modified for adding modules, keeping pace with new developments. The proposed AFM switching model is based on the Landau-Lifshitz-Gilbert equation (LLG). LLG along with an exchange coupling module is implemented with conventional electrical circuit elements like voltage-dependent current sources and capacitors. This proposed simulation can be performed for different user defines magnet parameters and initial magnet configurations. The model is carefully benchmarked with experiments. It can be used to study different AFM structures and corresponding switching capabilities. This provides the simulations required with good accuracy for high performance memory applications of AFM in high speed devices.

KEYWORDS

Compact model, SPICE, spin transfer torque, exchange coupling, Landau-Lifshitz-Gilbert (LLG) equation, antiferromagnet (AFM)