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Modeling of Spin-Transfer Torque Effects using a General Purpose Device TCAD Simulator

Modeling of Spin-Transfer Torque Effects using a General Purpose TCAD Device Simulator. We present an integrated simulation approach for spin-transfer torque (STT) devices within the framework of a general purpose TCAD device simulator: models for spin polarized tunneling currents and magnetization dynamics (Landau-Lifshitz-Gilbert equation) enable the simulation of both STT-RAM stacks and proposed logic devices like the spin-torque majority gate. Thermal fluctuations are modeled as a stochastic contribution to the driving force. Integration into a general purpose device simulator allows performing mixed mode simulations of STT devices together with their circuit environment as well as tightly integrated simulation of STT and conventional devices on a singe simulation geometry.

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Magnetic Exchange Interaction in Topological Insulators

Itinerant-driven magnetism in topological insulator is sensitive to the symmetry of surface electron states. Magnetic s-d interaction between local spins and slow surface electrons is represented in the basis which corresponds to real surface states, observable in angle-resolved photoemission spectroscopy (ARPES). Voltage-controlled RKKY-type interaction is calculated for surface and bulk magnetic impurities in the slab. Both the impurity spin configuration and the indirect exchange range function depend on the top-bottom surface tunneling and also on Rashba spin-splitting caused by an applied voltage across the slab as an inversion-symmetry breaking force.

COFFEE BREAK (GRAND SALON)

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Structural Optimization of MTJs for STT-MRAM and Oscillator Applications

STT-MRAM has all the characteristics of universal memory. However, the reduction of the switching current bears a challenge. A pronounced decrease of the switching time and current density in an in-plane MTJ with a free layer without the central region is predicted. We performed further structural optimization and propose a new design of the free layer, which combines the benefits of fast switching and easiness of fabrication. We extend the idea of using composite MTJs to nano-oscillators and propose a structure based on two MTJs with a shared free layer for frequencies tunable from a few GHz to several ten GHz.

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Co2FeSi Heusler Alloy: A Case Study on Half-metallicity and Spin Injection

Studies of spin injection from ferromagnetic metals into normal metals and semiconductors are of fundamental importance for development of spintronics devices. During last decade serious effort has been dedicated to identification of highly efficient spin injectors such as half-metallic ferromagnets and to studies of spin relaxation in non-magnetic materials. Here we present results of theoretical and experimental studies of spin injection from Co2FeSi and Co2FeMnSi Heusler alloys into gold films of variable thicknesses. Our main conclusion is that contrary to previous claims Co2FeSi is not half-metallic. This conclusion is based on: 1) direct measurements of spin polarized current using Andreev reflection at ferromagnet/superconductor and normal metal/superconductor interfaces; 2) drift-diffusion modeling of Andreev reflection experiments; and 3) Ab initio LDA+U calculations of the electronic structure of bulk Co2FeSi Heusler alloy. Using our drift-diffusion phenomenological theory we were able to determine the spin diffusion length in gold to be approximately 300 nm, which is consistent with the results obtained by other techniques.