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Editorial

Introduction to the special issue "Spintronics: Fundamental and applications"

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Spintronics is one of the emerging fields for the next-generation nanoscale devices offering better memory and processing capabilities with improved performance levels. It demonstrates great potential in the post-Moore era. Ever since the discovery of Giant Magneto-Resistance (GMR) effect in 1988, spintronics has shown a rapid progress. Recent advances have expanded this technology to the entire electronics industry of sensors, memories, oscillators, quantum information processors, computer architecture, brain-inspired computing and various other fields.

This Special Issue (SI) of the *International Journal of Applied Electromagnetics and Mechanics* (IJAEM), composed by a collection of 5 papers selected through a peer review procedure, presents the most recent developments and the state-of the-art in the field of spintronic devices, hybrid CMOS/spintronic circuits, and new architectures for high performance.

In the first article, Goksal et al. investigated the conditions under which an ultra-thin metallic antiferromagnet, Ir20Mn80 becomes susceptible to SOT effects by studying antiferromagnetic layer structure and thickness dependence in antiferromagnetic metal (Ir20Mn80)/heavy metal (Pt) superlattices. Their electrical measurements reveal that in bilayer structures there exists a shallow range of Ir20Mn80 thicknesses (~1–2 nm) for which SOT driven control of spins is apparent, whereas for lower thicknesses incomplete sublattice formation and for higher thicknesses improved thermal stability prohibits vulnerability to spin currents. They also show that in multilayers, structural changes in Ir20Mn80 layer quenches local torques due to stronger (111) magnetocrystalline anisotropy. These fundamental studies suggest that an exhaustive optimization of the antiferromagnet parameters is crucial for the successful deployment of spintronic devices.

In the second article, Pérez et al. investigated a double-barrier magnetic tunnel junction (DMTJ) to define STTMRAMs at the circuit-level. Simulation results point out that the tunnel-FET based solution is the most energy-efficient alternative, in terms of energy-delay-product (EDP), when evaluated at the 6σ corner. In addition, a leakage analysis is also carried out, showing that TFET-based STT-MRAM bitcells have lower leakage current as compared to the FinFET-based counterpart.

In the next article, Cutugno et al. exploited, by means of micromagnetic simulations at room temperature, a state-of-the-art nonresonant low-frequency-tail spin-torque diode in terms of dc output voltage as

a function of the amplitude of an in-plane external field applied along different directions. The authors find that there exists a threshold value of the injected ac current that promotes a linear behavior of the output voltage of field down to the pT range, and they suggest exploiting such a behavior for the design of a magnetic field sensor.

In the fourth article, Ding et al. proposed a sensorless control strategy of SPMSM based on an adaptive sliding mode observer (ASMO) with optimized phase-locked loop (OPLL) structure. The simulation and experimental results show that, compared with the CSMO, the improved SMO has better speed tracking ability, system estimation accuracy and fast dynamic response characteristics, and the high-frequency buffeting problem of the system is effectively suppressed.

In the last article, Rocha-Gómez et al. presented an angular position control, based on the Gaussian function, of a Magneto-Rheological fluid disc brake (MR brake) driven by a DC motor. Their strategy consists in the application of a continuous magnetic flux density to the MR brake, which will be maximum when the proportional controller of the DC motor reaches the desired position to brake the hybrid device.

We sincerely thank the reviewers and appreciate their efforts for timely reviews. We also thank all the authors for submitting their research to this Special Issue. We hope that you will enjoy reading these novel contributions.