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HoMMage

Hysteresis Design of Magnetic Materials for Efficient Energy Conversion

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Ferrimagnetic Tb(Gd)-Fe based heterostructures: From THz emitters to skyrmions

Abstract:

Ultrafast magnetization switching is at the heart of both modern information storage technology and fundamental science. In this regard, it was observed that ultra-fast magnetization reversal processes can be induced by circularly polarized laser pulses in ferrimagnetic (FI) GdFeCo alloy thin films [1]. This novel observation resulted in a broad range of exciting and challenging fundamental questions, and may enable new applications based on ultra-fast spintronics. In this regard, we have studied all-optical switching (AOS) in TbFe alloy thin films [2-4], and tried to combine this AOS property with high magnetic anisotropy material such as $L1_0$ ordered FePt, which are in high demand for ultra-high density magnetic recording [5]. In this attempt FePt-Tb alloy thin films were investigated [6].

Recently, a new type of spintronic THz emitter has been discovered, which is based on the inverse spin Hall effect [7]. These "spintronic" THz emitters typically consist of ferromagnetic/ nonmagnetic metal bilayers. In recent studies we have shown that bilayers consisting of FI Tb(Gd)-Fe alloys can be utilized as well as efficient spintronic THz emitters [8, 9]. We found that the THz emission amplitude closely follows the in-plane magnetization of the Fe sublattice. In a further study, we have applied the magnetic compensation temperature of a FI layer to control the THz emission solely by temperature [10], which opens a new route for a controllable and efficient type of spintronic terahertz emitter system enabled by the ferrimagnetic properties of rare earth-3d transition metal alloys.

FI multilayers can also be utilized to host various magnetic spin textures including magnetic skyrmions, which are promising candidates for future spintronic devices such as the skyrmion racetrack memory. Recently, we have shown the possibility to stabilize skyrmions and antiskyrmions in FI Gd/Fe based multilayers [11]. With micromagnetic simulations, we confirmed our observations and concluded that the reduction of saturation magnetization and uniaxial magnetic anisotropy leads to the existence of this zoo of different spin objects and that they are primarily stabilized by dipolar interactions. The observed coexistence of different topological protected spin objects provide great potential for further studies on quasi-particle interactions, spin dynamics as well as for possible future applications.

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About the speaker:

Manfred Albrecht received the Ph.D. degree in physics from the University of Konstanz (Germany) in 1999 and spent his postdoctoral time at the IBM Almaden Research Center in San Jose (USA). Afterwards he joined again the University of Konstanz heading an independent Emmy-Noether research group. In 2007, he was appointed Professor for Experimental Physics with the Chemnitz University of Technology (Germany). In 2013, he was appointed Chair for Experimental Physics IV at the University of Augsburg (Germany). His current research activities include magnetic thin films and nanostructures for spintronic applications including sensorics and THz emission, magnetic coupling phenomena as well as thermoelectric thin films.