Physikalisches Kolloquium

Universität Konstanz

Di 20.06.23
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im Anschluss Getränke und Snacks

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

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]. 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 thin films doped with Cr 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. Recently, we have shown the possibility to stabilize skyrmions and antiskyrmions in FI Gd/Fe based multilayers [11]. With micromagnetic simulations, we concluded that the reduction of saturation magnetization and uniaxial magnetic anisotropy leads to the existence of a 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.

[1] C. D. Stanciu et al., Phys. Rev. Lett. 99, 047601 (2007).
[2] A. Hassdenteufel et al., Adv. Mater. 25, 3122 (2013).
[3] A. Hassdenteufel et al., Phys. Rev. B 91, 104431 (2015).
[4] B. Hebler et al., Frontiers in Materials 3, 8 (2016).
[5] D. Weller et al., J. Vac. Sci. Technol. B 34, 060801 (2016).
[6] N.Y. Schmidt et al., Phys. Rev. B 102, 214436 (2020).
[7] T. Kampfrath et al., Nature Nanotechnology 8, 256 (2013).
[8] R. Schneider et al., ACS Photonics 5, 3936 (2018).
[9] R. Schneider et al., Appl. Phys. Lett. 115, 152401 (2019).
[10] M. Fix *et al.*, Appl. Phys. Lett. 116, 12402 (2020).

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