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Spin Seebeck effect in Fe_3O_4 heterostructures

A. Anadón,[1,2,*] R. Ramos,[3,4] I. Lucas,[1,2] P. A. Algarabel,[2,6] L. Morellón,[1,2] M. R. Ibarra[1,2,5] and M. H. Aguirre [1,2,5]

[1] *Instituto de Nanociencia de Aragón, Universidad de Zaragoza, Zaragoza, Spain.*
[2] *Departamento de Física de la Materia Condensada, Universidad de Zaragoza, Zaragoza, Spain.*
[3] *WPI Advanced Institute for Materials Research, Tohoku University, Sendai, Japan.*
[5] *Laboratorio de Microscopías avanzadas, Universidad de Zaragoza, Zaragoza, Spain.*
[6] *Instituto de Ciencia de Materiales de Aragón, Universidad de Zaragoza and Consejo Superior de Investigaciones Científicas, Zaragoza, Spain.*
[*] *anadonb@unizar.es*

The interaction between heat and spin currents has been a very active field of study and highly boosted recently since the discovery of the spin Seebeck effect (SSE). The mechanism and control of spin injection, detection and, in general, the optimization of SSE signal is still in progress. Fe_3O_4 epitaxial thin films with different thickness were deposited on a magnesium oxide substrate by means of pulsed laser deposition (PLD) in an ultrahigh-vacuum chamber. Anomalous Nernst effect (ANE) and SSE measurements were performed to careful study the characteristic dependence of thermomagnetic signal on the thickness of the magnetite. The experimental data is in agreement with reported models [1, 2] where the bulk spin current is calculated macroscopically with the Boltzmann equation for the magnon flow. Following this model the estimation of the magnon diffusion length in magnetite thin films is 17 ± 3 nm at 300 K.

SSE has also been investigated in highly crystalline magnetic multilayer Fe_3O_4/Pt films. Voltage as well as power generated by the SSE were found to be significantly enhanced with increasing the number of layers [3]. This voltage enhancement defies the simple understanding of the SSE and suggests that spin current flowing between the magnetic layers in the thickness direction plays an important role in multilayer SSE systems and the observed voltage enhancement.

References

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