MAR12-2011-001173

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Magnons, Spin Current and Spin Seebeck Effect

SADAMICHI MAEKAWA, Japan Atomic Energy Agency

When metals and semiconductors are placed in a temperature gradient, the electric voltage is generated. This mechanism to convert heat into electricity, the so-called Seebeck effect, has attracted much attention recently as the mechanism for utilizing wasted heat energy. [1]. Ferromagnetic insulators are good conductors of spin current, i.e., the flow of electron spins [2]. When they are placed in a temperature gradient, generated are magnons, spin current and the spin voltage [3], i.e., spin accumulation. Once the spin voltage is converted into the electric voltage by inverse spin Hall effect in attached metal films such as Pt, the electric voltage is obtained from heat energy [4-5]. This is called the spin Seebeck effect. Here, we present the linear-response theory of spin Seebeck effect based on the fluctuation-dissipation theorem [6-8] and discuss a variety of the devices.

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