Phonon driven nature of the spin-Seebeck effect in GaMnAs, MnAs, and MnAs/GaMnAs

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The spin-Seebeck effect is a spatial distribution of spins in a ferromagnetic material induced by a thermal gradient [1]. Here we describe measurements of the spin-Seebeck effect in the ferromagnetic semiconductor, GaMnAs[2], a related ferromagnetic metal MnAs, and their bilayers (MnAs/GaMnAs). The thermally induced spatial distribution of spins is inferred from the sign and magnitude of the inverse spin Hall voltage generated from local spin currents in platinum bars that are in electrical contact with the ferromagnetic material. The spin-Seebeck is not affected by electrical breaks showing that a flux of electron spins along the thermal gradient does not occur. Additionally, the phonon-driven nature of the effect is inferred from the correlation between the maximum in the spin-Seebeck coefficient at the temperature where phonons best conduct heat, and most strongly interact with electrons [3]. These measurements are also carried out in MnAs and MnAs/GaMnAs in which the GaMnAs ferromagnetic layer is exchange biased by the higher coercivity MnAs layer. This work was supported by the NSF and the ONR.

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