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Charge Voltages from Magnetization Dynamics[1]

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The main challenge of spin caloritronics is to establish a connection between heat currents and spin currents. Towards this end, spin Hall effects have become very important, since they allow to convert a pure spin current into a transverse charge voltage. I will show how these spin Hall effects can be characterized with great accuracy using spin pumping, where the excitation of ferromagnetic resonance generates a pure spin current in an adjacent non-magnetic conductor.[3] The change in the line-width of the ferromagnetic resonance determines the spin-mixing conductance and thus after proper calibration of the *rf* magnetic fields and the concomitant opening angles of the magnetization precession, allows to determine the magnitude of the spin current. The charge current generated from inverse spin Hall effect is measured through the associated electrical voltage and the ration of spin and charge current directly determines the spin Hall angle. Furthermore I will present an alternative approach for converting magnetization dynamics into measurable charge voltages. Namely, the dissipation of magnetization dynamics in thin films generally also results in a temperature gradient perpendicular to the film, since the supporting substrate acts as a heat sink. This in turn can generate a transverse voltage through the anomalous Nernst effect. Interestingly this allows to detect spin waves with very good signal to noise[4] and unlike optical or inductive detection techniques there is practically no lower limit for the wavelength of the detected spin waves.

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