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Spin Hall effect for detection of spin-currents – Realization of a Spin transistor

JOERG WUNDERLICH, Hitachi Cambridge Laboratory, Cambridge CB3 0HE, UK; Institute of Physics ASCR, v.v.i., Cukrovarnická 10, 162 53 Praha 6, Czech Republic

The realization of a viable semiconductor transistor and information processing devices based on the electron spin has fueled intense basic research of three key elements: injection, detection, and manipulation of spins in the semiconductor microchannel. The inverse spin Hall effect (iSHE) detection of spins manipulated by a gate electrode [1] has recently led to the experimental demonstration of a spin transistor device. [2] Here, the spin injection into a 2-dimensional electron gas (2DEG) was done optically in the depletion layer of a reverse biased pn-junction. [3] The iSHE detection is also used for electrical spin injection from a Fe electrode into a lateral GaAs channel combined with a simultaneous non-local spin valve measurement [4-10]. The spins in the channel are manipulated via the Hanle spin precession induced by an applied magnetic field and via a drift of electrons induced by an applied electric field. The output spin signal is suppressed or enhanced depending on the applied electrical bias rendering the device to a spin transistor different from the Datta Das concept. [11]

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