

Scattering Effects on a Spin Field Effect Transistor

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Utilizing electron spin degrees of freedom is a main theme of the so called spin electronics. One of representative spintronic devices is the spin field effect transistor (spin FET), which controls the electron flow by manipulating electron spin direction. This device, proposed in 1990 by Datta and Das, exploits the spin precession caused by the spin-orbit interaction in narrow gap semiconductors and uses ferromagnetic electrodes to realize spin-dependent electron flow. Despite the simplicity of its operating mechanism, it has eluded 14 years of experimental attempts to realize it and reasons for the failure are not clearly understood. In this talk, we study effects of electron scattering on the spin FET. For a special case of the spin FET made of a single-channel quantum wire, we derive a few necessary conditions for successful operation of the spin FET.

keywords : spin FET, spin-orbit coupling, scattering