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Conductance Oscillations in Spin Field-Effect Transistors

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Abstract: Ballistic spin transport in spin field-effect transistors is studied by taking into account the Rashba spin-orbit coupling, interfacial scattering, and band mismatch. It is shown that the spin conductance oscillation with the semiconductor channel length is a superimposition of the Rashba spin precession and spin interference oscillations. They have different oscillation periods π/k_R and π/k with k_R the Rashba wavevector and k the Fermi wavevector of the semiconductor channel, and play different parts of slow and rapid oscillations, depending upon the relative magnitude of π/k_R and π/k. Only at $k=k_R$ does the spin conductance exhibit oscillations of a single period. Two types of different behaviors of the tunnelling magnetoresistance are discussed.

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Key words: spin field-effect transistors, Rashba spin-orbit coupling

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