Ballistic Conductance in a Topological $1T'$-MoS_2 Nanoribbon

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A MoS_2 sheet in its $1T'$ phase is a two-dimensional topological insulator. It possesses highly conductive edge states which due to topological protection, are insensitive to back scattering and are suitable for device channels. A transition between the topological and conventional insulator phases in a wide $1T'$-MoS_2 sheet is controlled by an electric field orthogonal to the sheet. In order to enhance the current through the channel several narrow nanoribbons are stacked. We evaluate the subbands in a narrow nanoribbon of $1T'$-MoS_2 by using an effective $\mathbf{k} \cdot \mathbf{p}$ Hamiltonian. In contrast to a wide channel, a small gap in the spectrum of edge states in a nanoribbon increases with the electric field. It results in a rapid decrease in the nanoribbon conductance with the field, making it potentially suitable for switching.

Keywords: topological insulators, topologically protected edge states, nanoribbons, subbands, k.p Hamiltonian, ballistic conductance.

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