Spin valve device based on graphene nanoribbon with asymmetric edge-strain

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Spin-splitting can be induced in zigzag graphene nanoribbons (zGNRs) by means of defect engineering [1], transverse electric field effect [2] and strain engineering [3,4], which open perspective for device application. In this work, we explore the impact of the combined effect of strain and electron repulsion intensity in zGNRs for a spin-valve application. The calculations are based on a tight-binding Hamiltonian and a mean-field Hubbard model. The electron density is rigorously evaluated with the algorithm defined in [5] We demonstrate that asymmetric compressive and tensile edge strain along the direction of the ribbon section induces a spin-splitting of the low-energy band. Using the non-equilibrium Green's function formalism self-consistently coupled with Hubbard model, a gate-controlled spin-valve effect is achieved.

References

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Figures

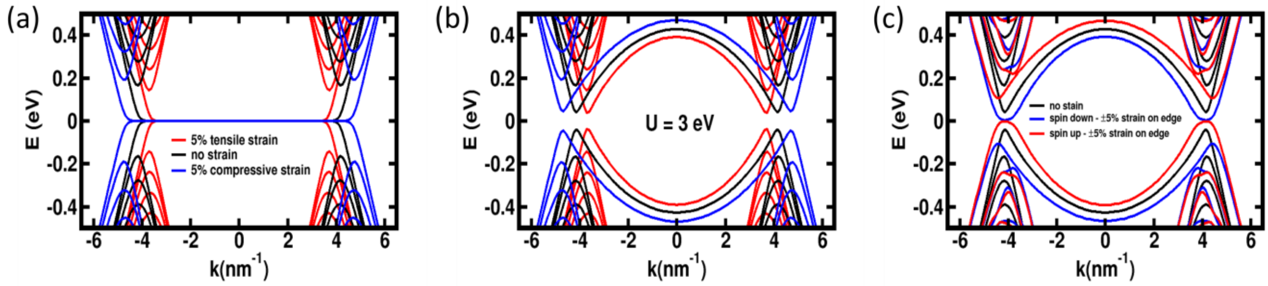

Figure 1: Energy bands of a 20 nm wide zGNR with (a) no Hubbard coupling, (b) Hubbard coupling U=3 eV, and (c) Hubbard coupling and a 5% compressive (tensile) strain on a 5 nm wide region at the bottom (top) edge strain.

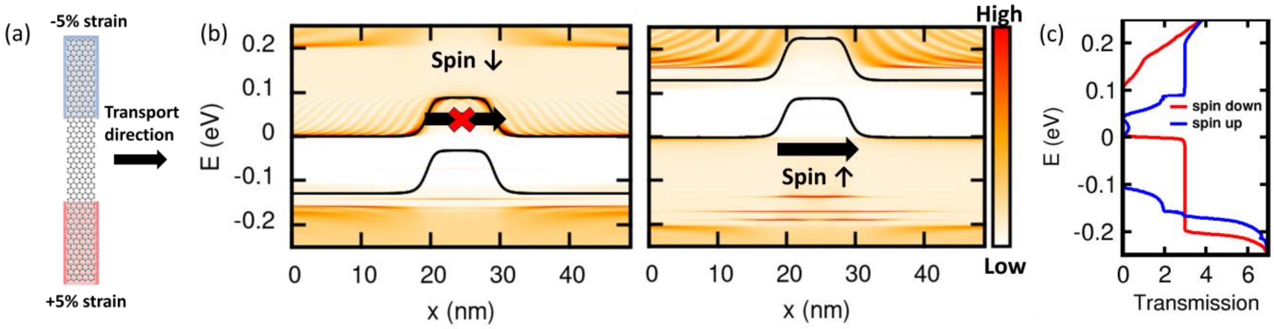

Figure 2: (a) Sketch of the asymmetric edge-strained zGNR simulated. (b) Spin-resolved local density of states along the transport direction for the spin-valve with a gate voltage of 0.1V. The barrier potential induced by the gate in the central region is found to filter only the spin down. (c) Corresponding spin-dependent transmission.