Spin manipulation in gated silicene nanoribbons

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Silicene [1], due to the strong intrinsic spin-orbit (SO) coupling [2,3] is very interesting in terms of spintronics applications.We consider gated silicene nanoribbons that exhibit spin-active properties with locally introduced Rashba SO interaction.We solved the spin transport problem for gated silicene nanoribbon using the atomistic tight-binding Hamiltonian [3] and we find that in nanoribbons with zigzag edges the vertical orientation of the Fermi electron spin is stabilized by the intrinsic SO interaction of the Kane-Mele form and that the Rashba SO interaction is too weak to flip the spin from $+z$ to $-z$ direction. The Kane-Mele SO interaction introduces a valley-dependent strong effective magnetic field oriented in the z direction [4]. We demonstrate that this effective field can be used for precession of the electron spins that are injected to the ribbon with the in-plane polarization x [FIG. 1(b),2(b)]. The tunable spin-splitting of the Fermi wave vector Δk [FIG. 2(a)] (via Fermi energy and gate voltage) produces high precession rates and spin inversion lengths lower than 10 nm.

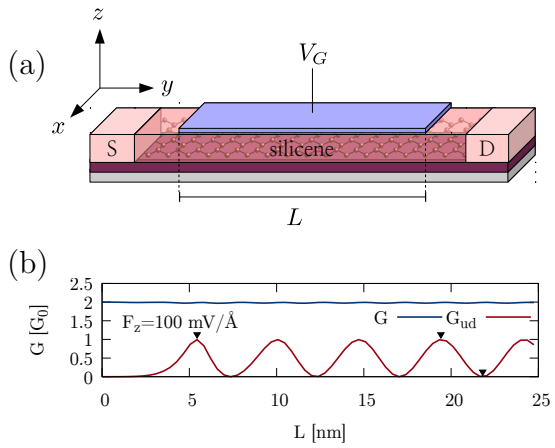

Figure 1: (a) Sketch of the considered system. (b) The total conductance G and its spin flipping contribution G_{ud} in function of variable top gate length L.

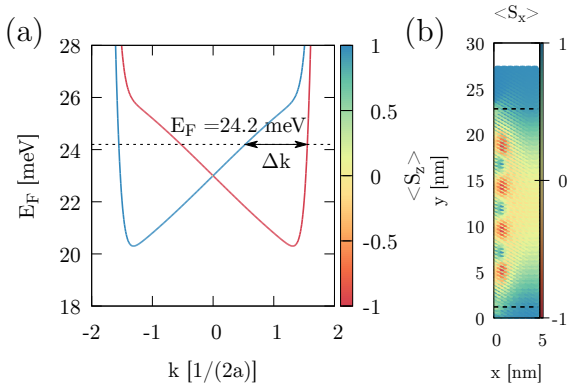

Figure 2: (a) Band structure for the first conductive subbands in the silicene zigzag nanoribbon in presence of external electric field 100mV/Å (color denote for the z projection of a spin). (b) Map of spin projection in x direction in the ribbon at E_F = 24.2 meV.

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