The effect of temporary magnetic hybridization of electron's wave functions on the charge flow in semiconductor bilayer nanostructure

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ABSTRACT

The nanosystem consisting of two vertically aligned nanowires exhibits specific transport properties when it is subjected to external magnetic field. The effect of magnetic field on electron transport in nanosystem of this type depends on mutual arrangement of the transport axis and the direction of magnetic field as well as the geometry of the bilayer nanosystem [1, 2, 3]. Very recently, we have predicted that an application of picosecond-like magnetic pulses [4] shall allow for temporary hybridization of vertical modes in single electron's wave function confined in bilayer nanowire. That, in consequence, shall change dynamically the momentum of an electron [5]. Here, we extend those considerations by taking into account the interparticle interactions for many electrons system. Based on the results obtained within the time-dependent DFT method we show that this kind of hybridization is still effective. Single magnetic pulse shots can permanently shift the single electron charge as well as a fraction of it, through e.g., the quantum point contact. This however can be done only if the confinement along the direction of tunnel coupling is asymmetric what makes the geometry of bilayer nanosystem crucial for this effect to operate. In such case, the strength of the magnetic coupling of two layers depends on the following factors: the degree of vertical asymmetry, an effective mass of electron and the time characteristics of the magnetic pulse.

References

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