Transmission of the Dirac ultrarelativistic quasi-electrons in the gapped graphene structures with the Fermi velocity barriers

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Within the framework of the continuum model, the transmission coefficient of the ultrarelativistic quasi-electrons *T* is calculated for the structure based on the gapped graphene. Two types of structures are considered: 1) the contact of two regions with different Fermi velocity values in each of them: that is the step-like velocity barrier; 2) the junction composed of three regions the middle of which has a Fermi velocity value that is different from the values in other regions (*υF*2 and *υF*1 respectively) and is considered as a velocity barrier which we believe to be of a rectangular shape. Calculations are carried out on the basis of the Dirac like equation for massive quasi-particles. The transmission coefficient is evaluated by means of the wave functions matching at the interfaces of the considered structures.

Some features of the transmission spectra (dependences of the transmission rates *T* on the parameter values) are common for both considered structures, namely: 1) magnitude of *T* is rapidly reduced with increasing in the energy gap ($∆)$ value (or the quasiparticle mass *m*); 2) spectra are highly anisotropic that is values of *T* markedly depend on the angle of incidence of the quasi-particle on the barrier $θ$; 3) function *T*($θ)$ oscillates with the parameter values, in particular with the $β$ = *υF*2/ *υF*1 value; 4) the Klein tunneling is suppressed for the case of *m* ≠ 0 ($∆\ne 0$). For the step like barrier, the function *T*(*E)* (*E* quasi-particle energy) is the monotonic and increasing with *E* one; there are no resonant energies. The function *T*($β) $can reveal the pronounced maximum and this function drops sharply to zero after reaching the maximum. For the rectangular barrier structure, a lot of maxima can be observed in the *T*(*E)* dependence as well as in the *T*($β) $function – these are the Fabry-Perot-type resonances. The specter *T*(*d*) (*d* being the barrier width) is characterized by the following features. The supertunneling phenomenon can be observed for $∆$ = 0. For nonzero $∆$ values, it is possible to observe two types of the function *T* (*d*). For small values of $β$, this function is an oscillating curve, and for sufficiently large values of $β$, the function *T* (*d*) is represented by a descending curve - as in the case of the conventional tunneling. More massive particles give values of *T* significantly smaller than less massive ones.