TRANSMITTIVITY OF A DISORDERED SUPERLATTICE WITH IMPURITIES IN THE POTENTIAL BARRIERS

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The electron transmission rates across a disordered superlattice (SL) with impurities in the potential barriers is evaluated. It is assumed that parameters of the impurities vary along the SL chain, obeying the Gauss law, and the quantum well widths are distributed at random. The structure considered reveals high transparency in a wide range of the values of the parameters, and it becomes practically transparent for resonant energies.

Deep-lying impurities located in the potential barriers strongly affect the energy spectra of various resonant tunneling structures (RTS) such as periodical SL [1], single barrier RTS ([2] and references therein), double barrier RTS [3], hierarchical SL [4], quasiperiodical Fibonacci SL [5]. In this work, the tunneling transmittivity of a disordered SL with impurities in the potential barriers is evaluated. Disorder is caused by two factors: the distribution of the parameters of impurity centers along the SL obeys the Gauss law, the quantum well widths are distributed randomly along the SL.

Consider SL consisting of a finite sequence of one-dimensional rectangular potential barriers of the same width d and height V. Suppose that a flux of electrons with energy E is traveling along the x-axis, with the effective mass of the charge carriers independent of x. Suppose that x axis is perpendicular to the interfaces and that each barrier contains only one "impurity plane" [1,3]. The potential of the scatterers is modeled by a delta function of the strength Ω. Within a framework of the effective mass approximation the solution of the Schoedinger equation describing electronic states inside the barriers as well as in the wells, can be obtained with the help of the transfer-matrix technique. The form of a matrix transferring the solution across interfaces **R** is well known, the matrix transferring the solution across the impurity planes **M** is given e.g. in [6]. The transmission coefficient of an electron across the SL is

$$T(E) = \left|\left(\prod_{n=1}^{r} R'_n\right)_{11}\right|^2 \tag{1}$$

where r is the number of barrier-well interfaces, for n even we have $R'_n = R_n$ for n odd, $R'_n = R_{2s-1}M_s$, s= 1, 2, 3, ... We calculate T(E) via (1) for the parameters $m=0.2m_0$, V=0,4eV which correspond to Si-SiC structure. If the distance from the impurity plane to the nearest interface is equal to pd we assume that the distribution of the quantity p along the SL chain obeys the Gauss law with the spread σ_p , distribution of quantity $\beta=2m\Omega$ along SL obeys the same law with the spread σ_β. The quantum well width distribution is assumed Gaussian with a large spread sufficient to make this distribution