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Effect of the conduction zone filling degree on the energy position of localized electron state at dislocation wall

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Within the frame of electron-deformation connection model, energy of the ground electron state localized at a dislocation wall has been calculated for ZnSe/GaAs (100) heterostructure as a function of the conduction zone filling at different distances d between the misfit dislocations. At $d \geq 2000$ Å, the ground electron state energy in periodic electron deformation potential wells of Kronig-Peny type has been shown to be essentially the same as in smooth-boundary ones. The effect of electron subsystem, in particular, of the conduction band filling degree, in heterostructures with higher misfit of lattice parameters has been found to be manifested stronger than in slightly misfit ($\Delta a/a \leq 1$ %) ones.

В рамках модели электрон-деформационной связи рассчитано энергию основного состояния электрона, локализованного на дислокационной стенке, в гетероструктуре ZnSe/GaAs (100) в зависимости от степени заполнения зоны проводимости при разных расстояниях d между дислокациями несоответствия. Показано, что при $d \geq 2000$ Å энергия основного состояния электрона в периодических электрон-деформационных потенциальных ямах типа Кронига-Пени практически такая же, как и в периодических электрон-деформационных потенциальных ямах с плавными границами. Установлено, что в гетероструктурах с большей несогласованностью параметров решёток на гетерогранице влияние электронной подсистемы, в частности, степени заполнения зоны проводимости, проявляется сильней, чем при малой несогласованности ($\Delta a/a \leq 1$ %).

Crystal heterostructures with mismatched lattice parameters extend the range of semiconducting heterosystems suitable to be applied in modern light diodes and heterolasers. The emission spectrum of the latter can be varied by changing mechanical stresses in contacting layers using electric field [1].

The lattices in contact are strained due to their mismatch at the interface. The strain can be resolved into an isotropic component and a uniaxial one and its character depends on the distance h between the ZnSe layer and ZnSe/GaAs (100) interface [2, 3]. In ZnSe layers thinner than critical value h_c, biaxial compressing strains arise in the plane parallel to the interface decreasing within the range $h_c < h < h_1 \approx 0.88$ μm (h_c is the distance between the interface and ZnSe layer at which misfit dislocations parallel to each other and approximately equidistant form so-called misfit dislocation wall, Fig. 1).

In [4], the electron spectrum of strained ZnSe/GaAs heterostructure as a function of the interdislocation distance has been calculated within the frame of mechanical strain-potential model. Experimental data [5–7] evidence the mutual influence of the lattice