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Multilayered structures $InSb_{1-x}Bi_x$/InSb-materials for infrared photodetectors

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In the work investigations of electron energy spectrum dependence from thickness (l) and number (N) of layers are carried out as well as treating with rays process in 5-11 layer heterostructures $InSb_{0.97}Bi_{0.03}$/InSb is considered by kp- and matrix methods. Calculations verified by experiments[1] show that with an addition of every pair of layers (well/barrier) there is an energy level appearance. N-increasing leads to spectrum displacement into the NIR-field. For thick ($l>0.1$ mcm) layers it's typical high NIR-sensitivity.

Because of the continuity of electromagnetic field tangential constituents at the heteroboundary the transfer matrix Z is single. Through the all multilayer structure Z is the product of Z_i through N_i layers beginning at the side of illumination. With N-increasing there is a rise of the superlattice reflection coefficient R. When $N=11$, $R\to1$, i.e. structure is almost an ideal reflective coating (illumination angle $\alpha=0$, $\lambda=7.7$ and 11 mcm, $l=0.1$ mcm). For $\alpha=0$ there is a transparency maximum. If $N=3$, the transparency coefficient $P\to0.8$, with N-increasing up to 17P decreases to 0.3. When $\alpha=0-\pi/2$, $P=0.8-0$. So varying illumination angle one can obtain required P and R without changing of multilayer structure configuration.

Superlattice properties can be used in infrared photodetectors, clarified coatings, heterojunction smoothing to avoid degradation of frequency characteristics and Q-factor because of the energy band gaps in sharp heterojunctions.

References

[1] L.S.Lunin, M.L.Lunina, A.V.Blagin Avalanche photodiodes on the base of InSbBi-InSb superlattice./Proc. Of VII International conference "Actual problems of solid state electronics and microelectronics". Divnomorskoe, Russia, 2000, V.2. P.172.

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