Narrow-gap solid solutions on the base of $A_{III}B_{V}$ semiconductors are perspective materials for solid state electronics: creation of infrared detectors, low-noise filters for communication systems and lasers with smooth reconstruction of length width. Traditional solutions on the base of $A_{III}B_{V}$ semiconductors do not give the possibility to increase wave length range more than $7.5 \, \mu m$. Creation of photoelectronic devices in far infrared region requires synthesis of new solutions or strained heterostructures. $\text{InSb}_{1-x}\text{Bi}_x$ crystals with zinc-blende structure are the solutions with expected properties and we investigate them in present paper.

Using local empirical pseudopotential with spin-orbit interaction taking into account the electron band structure of $\text{InSb}_{1-x}\text{Bi}_x$ in virtual crystal approximation is calculated. For binary compounds $\text{InSb}$ and $\text{InBi}$ characteristic gaps between energy bands in high symmetry points of Brillouin zone satisfactorily coincide with known experimental results. Dependencies of forbidden band gap of the solid solution at different temperatures are presented in figure [1]. Continuous curves are the result of our calculations. Temperature dependencies were calculated with the use of Brooks-Yu method. On the base of correctly calculated band structure we estimated four energy band masses ($m_c$, $m_{hh}$, $m_{lh}$, $m_{soh}$), which are in good agreement with cyclotron resonance measurements. Knowledge of pseudopotential wave functions gives us the possibility to calculate space distribution of electron charge density $\rho(r)$ and investigate nature of chemical bonds in $\text{InSb}_{1-x}\text{Bi}_x$ solid solution. Baldereschi’s special points scheme was used to perform the summation over Brillouin zone. For our system $\rho(r)$ demonstrates charge transfer for different values of composition $x$.