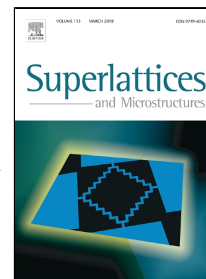


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The localized effect of the Bi level on the valence band in the dilute bismuth $\text{GaBi}_x\text{As}_{1-x}$ alloy

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Abstract: The research on the temperature dependence of the band gap energy of the dilute bismuth $\text{GaBi}_x\text{As}_{1-x}$ alloy has been done. It is found that its temperature insensitiveness is due to the enhanced localized character of the valence band state and the small decrease of the temperature coefficient for the conduction band minimum (CBM). The enhanced localized character of the valence band state is the main factor. In order to describe the localized effect of the Bi levels on the valence band, the localized energy is introduced into the Varshni's equation. It is found that the effect of the localized Bi level on the valence band becomes strong with increasing Bi content. In addition, it is found that the pressure dependence of the band gap energy of $\text{GaBi}_x\text{As}_{1-x}$ does not seem to be influenced by the localized Bi levels. It is due to two factors. One is that the pressure dependence of the band gap energy is mainly determined by the Γ CBM of $\text{GaBi}_x\text{As}_{1-x}$. The Γ CBM of $\text{GaBi}_x\text{As}_{1-x}$ is not influenced by the localized Bi levels. The other is that the small variation of the pressure coefficient for the Γ valence band maximum (VBM) state of $\text{GaBi}_x\text{As}_{1-x}$ can be cancelled by the variation of the pressure coefficient for the Γ CBM state of $\text{GaBi}_x\text{As}_{1-x}$.

Key words: $\text{GaBi}_x\text{As}_{1-x}$; Bi level; Band gap energy; dilute bismuth

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