How to use type II InAs/GaSb superlattice structure to reach detection wavelength of 2-3 μm?

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Type II InAs/GaSb superlattice (SL) structure has many advantages for infrared photodetector applications and its detection wavelength is proved to be able to cover the range of about 3 to 30 μm by tuning the constituent layer thickness and the thickess ratio of InAs to GaSb. However, it has been an important aspect to push the detection wavelength into the short wavelength range of 2-3 μm by using the type II SL structure. This paper [1] tries to answer an important question: is it possible to use type II SLs to reach detection wavelength of 2-3 μm and how to realize it?

We reveal that a strong In intermixing occurs during the growth of InAs/GaSb SL structure. The In intermixing is strongly related to the growth temperature and can have a very big impact on the short period SL band structure and is the reason why a detection wavelength smaller than 3 μm can't be realized for a SL structure like InAs (3 ML)/GaSb (3 ML). Concretely, we find that the infrared photoluminescence (PL) peak of an InAs (8 Å)/GaSb (9 Å) SL structure is shifted from 5.8 to 4.0 μm at 77 K when the growth temperature is lowered from 380 to 340 ℃. This blueshift of the PL peak is attributed to the reduced In intermixing due to a lower growth temperature. To reduce the influence of the In intermixing on the SL band structure, besides lowering the growth temperature, another effective scheme is to increase the GaSb layer thickness in the SL structure. Experimentally, we find that the PL peak of an InAs (8 Å)/GaSb (21 Å) SL structure grown at 380 ℃ reaches 2.7 μm at 77 K. By using this SL structure, the 50% cutoff wavelength of a *p-i-n* type of detector reaches 2.56 μm at 77 K.

[1] J. L. Huang, W.Q. Ma, Y. Wei, Y.H. Zhang, K. Cui, Y.L. Cao, X.L. Guo, and J. Shao, IEEE J. Quantum Electron. **48**, 1322 (2012).