

Type-II GaSb/InAlAs quantum dots grown on InP (001) substrate by droplet epitaxy

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Abstract (250-Word):

The GaSb quantum dots (QDs) with type II band alignment have attracted great attention recently. They are predicted to be optimizing active region materials for achieving high efficient intermediate-band solar cells and for obtaining ultra-long storage time for memory cells. In this research, GaSb QDs sandwiched inside InAlAs matrix lattice-matched to InP (001) substrate have been obtained via droplet epitaxy. The droplet epitaxy enable us to achieve low density ($\sim 2.6 \times 10^9/\text{cm}^2$) and large size (average height $\sim 6.5\text{nm}$) for the QDs while the lattice mismatch between the GaSb and InAlAs matrix is only $\sim 4\%$. PL measurements reveal a type-II band alignment for these GaSb/InAlAs/InP QDs. The PL peak energy of QDs shows a blue-shift of $>100\text{ meV}$ when the laser intensity increases by six orders of magnitude. Time-resolved PL measurements further confirm the type-II band alignment for the QDs by showing a maximum carrier lifetime of $\sim 4.5\text{ ns}$. The abnormal dependence of peak energy of QD PL band on the temperature in together with the special PL decay curve indicate that these GaSb/InAlAs QDs likely have different physics mechanism from common GaSb/GaAs type-II QDs. This study provide useful information for understanding the band structure and carrier dynamics of the GaSb/InAlAs QDs grown on InP surface.

Abstract (100-word): The GaSb/InAlAs quantum dots have been grown on InP (001) substrate via droplet epitaxy. Photoluminescence (PL) investigations indicate a type-II band alignment for these quantum dots. Time-resolved PL measurements further confirm this type-II band assignment by show a long carrier lifetime of a few nanoseconds. In particular, The abnormal dependence of peak energy of QD PL band on the temperature in together with the special PL decay curve indicate that these GaSb/InAlAs QDs is likely have different physics mechanism from common GaSb/GaAs type-II QDs. This study provide very useful information for understanding the type-II GaSb QDs on InP surface.