砷化鎵/磷化銦鎵鎵異質結構介面的LP-MOCVD成長與研究及其在蝕刻阻障層的應用

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摘　　要

本論文以低壓有機金屬汽相沉積法(LP-MOCVD)在磷化銦鎵上成長砷化鎵，由於材料本身的特性，會在介面上自發性的產生磷砷化銦鎵。此四元混合層使 InGaP/GaAs HBT 的電流增益下降並降低蝕刻時的選擇比，因此在磷化銦鎵上成長砷化鎵時，減少四元混合層的厚度，將使元件的性能大大的增加。

在我們的實驗中，成長完磷化銦鎵後，以較低的溫度成長砷化鎵，這將使磷化銦鎵表面的磷原子較不易脫附，因此可顯著的減少磷砷化銦鎵四元混合層的厚度。此外，較低的磷原子脫附速率，可增加三氫化磷的中斷時間，這使的反應腔中殘留的三氫化磷明顯的減少，並減少磷砷化銦鎵的形成，從 LT-PL 及 TEM 的資料中，都可得到一致的證明。

最後我們以最佳化的條件，在砷化鎵中成長極薄的磷化銦鎵蝕刻阻障層，藉由實際的蝕刻的製程，我們發現 20Å 的磷化銦鎵蝕刻阻障

層，可承受45秒的蝕刻而不被貫穿。因次，藉由我們最佳化的成長條件，可使傳統的砷化鎵/磷化銦鎵材料系統中所需的磷化銦鎵蝕刻阻障層的厚度顯著的減少。

The Study of GaAs/InGaP Heterostructure Grown by LP-MOCVD and Its Application to Etching Stop Layer

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Abstract

In this study, we grow GaAs on InGaP by LP-MOCVD. Due to the material property of GaAs/InGaP material system, the InGaAsP intermixing layer formed spontaneously in the interface. This quaternary intermixing layer reduced HBT current gain and etching selectivity. Therefore as GaAs was grown on InGaP, the thinner the InGaAsP layer the better the performance of our devices.

As our experiments were concerned, the after growth of InGaP, GaAs was grown at a lower temperature than that for InGaP. This made the P atoms on the InGaP surface hard to desorb and greatly reduce the thickness of InGaAsP intermixing layer. In addition, the lower desorption rate of P atoms increases the PH_3 off time. This reduced the residual PH_3 in the reactor chamber dramatically and restrained the formation of InGaAsP layer. Both the data of LT-PL and TEM confirmed the experimental results discussed above.

Finally, we used the optimum conditions to grow an InGaP etching stop layer between GaAs layers. By carrying out the etching process, we found a 20Å InGaP etching stop layer will not be penetrated if the

etching time were less than 45 sec. By using our optimum growth conditions, the required thickness of InGaP etching stop layer of GaAs/InGaP material will be greatly reduced.

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