國立交通大學

工學院半導體設備與製程在職專班

碩士論文

應用在無線通訊的假型高電子遷移率電晶體(PHEMT)之線性度的研究與改善

研究生：廖經文

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中華民國九十六年九月

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Linearity Improvement of InGaP/InGaAs PHEMT for Wireless Communication Applications

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摘要

這篇論文為研究假型高電子遷移率電晶體(PHEMT, pseudomorphic high electron mobility transistors)之線性度改善,,此研究先由分析三次交互調變失真(IM3)及三次交叉點(IP3)與轉導值(Transconduction)之間關係.由推導的結果得知,越平坦的轉導分布圖形,元件的線性度越好.因此本研究分兩大部分去探討元件線性度的改善.

首先,我們利用假型高電子遷移率電晶體(PHEMT),來發展低雜訊暨高線性度之元件.此研究室以一般平面性摻雜的磷化銦鎵/砷化鎵元件為基準,分別額外的摻雜電子在蕭特基層及通道層,探討額外的電子摻雜在不同層時對元件線性度的影響.最後驗證出額外摻雜電子在元件上會使得元件之最大轉導值下降,但其分部會更為平坦,而使得元件之線性度提升.

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Abstract

In this paper , δ-doped InGaP/InGaAs pseudomorphic high-electron-mobility transistors (HEMTs) with doping profile modification are investigated in order to improve the device linearity. The modification was based on the linearity analysis using a simple equivalent circuit of the devices. The correlation of the extrinsic transconductance (Gm) with IM3 & IP3 indicates that the flatness of Gm, as a function of gate-bias causes a lower IM3 level. On the other hand, a high Gm with a flatter Gm distribution results in a higher IP3 value for the device. Therefore, doping modifications that improve the flatness of the Gm distribution will also improve the device linearity.

Doping modifications in the Schottky layer (uniformly-doped) and in the channel layer (channel doped) of the conventional δ-doped InGaP/InGaAs pHEMT were investigated. It was also found that extra doping in the channel region and usage of uniformly doped device improves the flatness of the Gm distribution under different gate-bias condition. This achieved an excellent ACPR (adjacent-channel power ratio) with a small sacrifice in the peak Gm value.

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誌謝感言

對一個在職專班學生而言,能像一般生般一窺學術殿堂,要是沒有許多人的協助及熱心指導,是不可能完成此一從 device 製造到測試的論文.

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