

# 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

指導教授：張翼博士

中華民國九十六年九月

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Linearity Improvement of InGaP/InGaAs PHEMT for  
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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.

# **Linearity Improvement of InGaP/InGaAs PHEMT for Wireless Communication Applications**

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## **Abstract**

In this paper ,  $\delta$ -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 ( $G_m$ ) with IM3 & IP3 indicates that the flatness of  $G_m$ , as a function of gate-bias causes a lower IM3 level. On the other hand, a high  $G_m$  with a flatter  $G_m$  distribution results in a higher IP3 value for the device. Therefore, doping modifications that improve the flatness of the  $G_m$  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  $\delta$ -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  $G_m$  distribution under different gate-bias condition. This achieved an excellent ACPR (adjacent-channel power ratio) with a small sacrifice in the peak  $G_m$  value.

# Contents

Abstract (in Chinese)

Abstract (in English)

Acknowledgement

Contents

## Table Captions

Figure Captions

Chapter 1 Introduction	01
Chapter 2 Device Linearity Analysis for improvement	05
2-1 Introduction	05
2-2 Device model	05
2-3 The nonlinear effect of device	07
2-3-1 Gain compression	07
2-3-2 Analytic of IM3 and IP3	08
2-4 Transconductance ( $G_m$ )	11
2-5 Polynomial curve fitting technique	12
Chapter 3 Device structure & PHEMT Experimental	14
3-1 Device structure	14
3-2 Introduction of PHEMT process	16
3-2-1 Device active region definition (mesa)	16
3-2-2 Ohmic metal deposition and annealing	17

3-2-3 Recess and gate formation	18
3-2-4 Device passivation	19
3-2-5 Air-bridge plating	20
Chapter 4 Instruments & Measurements	32
4-1 Instruments	32
4-2 DC characteristics measurement	32
4-2-1 Contact properties	33
4-2-2 Current-voltage curves	33
4-2-3 Pinch-off voltage ( $V_{PO}$ ) & Breakdown voltage ( $V_B$ )	34
4-2-4 Extrinsic transconductance ( $g_m$ )	34
4-3 RF characteristics measurement	35
4-3-1 Scattering parameters (S-parameters)	35
4-3-2 Third-order intercept point (IP3)	35
Chapter 5 Results and Discussion	39
Chapter 6 Conclusions	52
References	

## Table Captions

Table 5-1 The comparison of the electron DC properties of InGaP PHEMT with different doping.

Table5-2  $P_{1dB}$ , Gain, PAE and ACPR of the three different devices under different  $V_{DS}$  at class AB bias.



## Figure Captions

Figure 1-1 The band diagram of the InGaP PHEMT

Figure 2-1 HEMTs structure and its equivalent circuit model

Figure 2-2 Output power spectrum of the two-tone input signal.

Figure 3-1 Process flow of the InGaP PHEMT: (a) Mesa isolation and ohmic contact formation, and (b) gate recess and gate formation. (c) Device passivation and contact via formation, and (d) air-bridge plating.

Figure 3-2(a) structure of conventional delta doped PHEMT.

Figure 3-2(b) structure of channel doped PHEMT.

Figure 3-2(c) structure of Schottky layer with uniform Si  $2 \times 10^{18} \text{ cm}^{-3}$

(top)/  $2 \times 10^{18}$  (bottom)  $\text{cm}^{-3}$  PHEMT

Figure 3-2(d) structure of Schottky layer with uniform Si  $3 \times 10^{18} \text{ cm}^{-3}$

(top)/  $2 \times 10^{18}$  (bottom)  $\text{cm}^{-3}$  PHEMT

Figure 3-4 mesa pattern image from microscope.

Figure 3-1 Process flow of the InGaP PHEMT. (a) Mesa isolation and



ohmic contact formation. (b) Gate recess and gate formation.  
(c) Device passivation and contact via formation. (d)  
Air-bridge plating.

Figure 3-2 The epitaxial structure of the InGaP PHEMT.

Figure 3-3 The band diagram of the InGaP PHEMT.

Figure 3-4 The SEM image of the transmission line method (TLM)  
patterns.

Figure 3-5 The ohmic contact pattern from microscope image

Figure 3-6 The SEM image of the T-shaped gate.

Figure 3-7 The SEM image of the  $0.5 \mu\text{m}$  InGaP PHEMT.

Figure 3-8 The Image of the finished  $0.5 \times 160 \mu\text{m}^2$  HEMT device

Figure 3-9 The image of the finished PHEMT device.

Figure 4-1 The transmission line method (TLM). (a) TLM patterns. (b)  
TLM measurement method.

Figure 4-2 The noise figure measurement system.

Figure 4-3 IP3 measurement system diagram.

Figure 4-4 Output power spectrum.

Figure 5-1 (a)  $I_{\text{DS}}$  versus  $V_{\text{DS}}$  curve for the conventional  $\delta$ -doped  
InGaP PHEMT.

Figure 5-1 (b)  $I_{\text{DS}}$  versus  $V_{\text{DS}}$  curve for the channel-doped InGaP PHEMT.

Figure 5-1 (c)  $I_{\text{DS}}$  versus  $V_{\text{DS}}$  curve for the schottky uniformity-doped  
( $2 \times 10^{18} \text{cm}^{-3}$  (top),  $2 \times 10^{18}$  (bottom) $\text{cm}^{-3}$ )  
InGaP PHEMT.

Figure 5-1 (d) $I_{DS}$  versus  $V_{DS}$  curve for the schottky uniformity-doped  
 $(3 \times 10^{18} \text{ cm}^{-3} \text{ (top)}, 2 \times 10^{18} \text{ (bottom) cm}^{-3})$

InGaP PHEMT.

Figure 5-2 (a)  $G_m$  versus  $V_{GS}$  curve for the Schottky-doped InGaP PHEMT.

Figure 5-2 (b)  $G_m$  versus  $V_{GS}$  curve for the Schottky & channel doped  
 InGaP PHEMT.

Figure 5-3 (a)  $I_{DS}$  versus  $V_{GS}$  curve for the uniform-doped  
 InGaP PHEMT.

Figure 5-3 (b)  $I_{DS}$  versus  $V_{GS}$  curve for the Schottky & channel doped  
 InGaP PHEMT.

Figure 5-4 (a)(b) ACPR spectrum of the channel doped InGaP/InGaAs  
 PHEMTs (device size:  $0.5 \times 160 \mu\text{m}^2$ ) (a) bias condition:  
 $V_{ds}=1.5\text{V}$ , class AB and the input signal frequency is 2 GHz  
 (b) bias condition:  $V_{ds}=1.5\text{V}$ , class A and the input signal  
 frequency is 2 GHz.

Figure 5-4 (c) (d) ACPR spectrum of the uniform doped InGaP/InGaAs  
 PHEMTs (device size:  $0.5 \times 160 \mu\text{m}^2$ ) (c) bias condition:  
 $V_{ds}=1.5\text{V}$ , class AB and the input signal frequency is 2 GHz (d)  
 bias condition:  $V_{ds}=1.5\text{V}$ , class A and the input signal  
 frequency is 2 GHz.

Figure 5-4 (e) (f) ACPR spectrum of the conventional  $\sigma$  doped  
 InGaP/InGaAs PHEMTs (device size:  $0.5 \times 160 \mu\text{m}^2$ ) (e) bias  
 condition:  $V_{ds}=1.5\text{V}$ , class AB and the input signal frequency is 2  
 GHz (f) bias condition:  $V_{ds}=1.5\text{V}$ , class A and the input signal  
 frequency is 2 GHz. Figure 5-12 The  $IP_3$  of the  $300 \mu\text{m}$  gate  
 width InGaP PHEMT under  $V_{ds}=2.4\text{V}$ ,  $I_{ds}=27.7\text{mA}$  bias.

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