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### 中文摘要

在此論文中，我們首先針對不同厚度的五環素(pentacene)做材料方面的分析，以原子力顯微鏡(AFM)探究表面的輪廓，以及 X 射線繞射(XRD)量測，來分析材料品質，並且與製作成元件的電特性相比較。在此製程當中，五環素厚度為  $1000\text{\AA}$  時，可以得到最佳的特性。在變量測溫度方面，我們發現隨著溫度升高，電流增加，載子的遷移率(mobility)也隨之上升，然而到了臨界的溫度之後，汲極(drain)電流在飽和區的時候會有降低的現象發生，我們將此現象歸因於自我致熱(self-heating)現象所致。這也是由於溫度升高，晶格之間擾動造成的散射效應所導致。在不同溫度的量測之間，我們亦萃取了活化能(activation energy)並找出其和閘極偏壓之間的關係，同時和常見的邊界位障降低的模型(grain boundary barrier lowering model)做比較。

在有機薄膜電晶體當中，接面電阻的效應是格外嚴重的。我們利用電流和電壓以及通道長度  $L$  之間的相關性，來萃取出和通道長度  $L$

不相關的接面電阻部份，並且也找出接面電阻和閘極偏壓之相關性。

除此之外，不同溫度量測得到的接面電阻可以釐清在溫度改變時，特性變化產生的原因。

在提升有機薄膜電晶體特性的方法之中，表面處理是一種相當有效且直接的方式。在本實驗中，我們利用 HMDS(Hexamethyldisilazane) 來做為表面處理的材料，實驗結果也可驗證表面處理對於元件的特性是有助益的。



# Researches on Pentacene-Based Thin-Film Transistors

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## Abstract

In this thesis, we first discuss the material characteristics of the pentacene-based OTFTs with different pentacene film thicknesses. The grain size and film quality can be analyzed by AFM and XRD measurements, respectively. The performances are the best for the 1000Å-thick device.

By changing the measurement temperatures, we find the drain current and mobility get larger as the temperature increases. After the critical temperature, the lattice vibration is more severe and the drain current decreases in the saturation region due to scattering which is the so-called self-heating effect. We also extract the activation energy from the measurements of different temperatures and find its gate voltage dependence, which corresponds to the generally-used grain boundary barrier lowering model.

The effect of contact resistance is especially serious in OTFTs. We extract the contact resistance by using the relationship between the drain current and drain voltage and channel length  $L$ . The dependence of the gate bias on the contact resistance is also investigated.

Among the methods for improving the characteristics of the OTFTs, surface

treatment is an effective one. We use HMDS (Hexamethyldisilazane) for surface treatment and the performances of devices after surface treatment are much improved.



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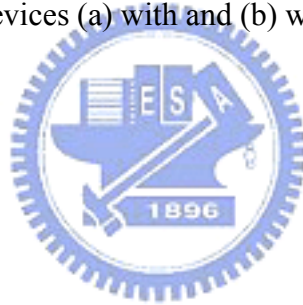


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## Acknowledgements

在電資前盛滿的荷花池走進記憶之前，碩士班的生活也接近尾聲。兩年的研究生涯，感謝指導老師李柏聰老師兩年來不管是在研究上或者生活當中的殷殷教誨，使我獲益良多，也非常感謝冉曉雯老師在學業以及研究方面給我許多指點和提攜，為我解決許多研究上的困難。並且很感謝趙天生老師以及劉柏村老師撥空擔任口試委員，也在此謝謝兩位老師的指教。

在實驗的過程當中，感謝工研院電子所提供試片以作為我論文研究的材料，以及長官和學長姐在研究上給予我的指導與照顧，得以讓合作計畫順利完成，也讓我在研究上獲益匪淺。

研究的過程當中，不同的階段感謝許多幫助我的朋友，雖然或有挫折卻也擁有許多美好回憶作為支撐。謝謝我的良師益友國錫，不管是在想法的實現，實驗的力行，以及研究態度上都讓我學習成長許多，一起做研究的日子充滿了對研究的熱忱以及挑戰夢想的堅持。感謝世青學長機台教學和一些實驗的指導，和學長一起做實驗的時光也是很難忘的。感謝實驗室夥伴贊文，竑鈞，以及吉東，四人一起在全新的實驗室長大。也謝謝彥甫平常給我的打氣和鼓勵，凱傑，士欽，中良，政偉，兆仟，銘龍，德章，士哲，承和，宏光，承丘等人在研究方面提供許多意見，不管是在課業上或者生活上都是好夥伴。謝謝學弟溥寬，傑斌在實驗上的協助，讓我後期的實驗能夠完成。特別要感謝實驗室學弟書志，國輝，鴻祺，峻豪，資岳，豐懋的陪伴，讓我的研究生生活增添了許多鮮明的回憶，就像是兄弟一般的情感也讓我在研究及生活上得到許多鼓舞。同時我也在此感謝在我身邊鼓勵我，給我力量，以及一同渡過美好時光的所有朋友們。

我要感謝我最摯愛的家人們，謝謝我的爸媽一路走來給我最完全的支持養育，和關愛，使我得以順利的完成學業，並且帶著你們給我的溫暖繼續前行。感謝哥哥從小到大的相互扶持，照顧我，也希望我們都能揮灑出屬於自己的一片天。感謝女友怡靜一直以來的陪伴，以及分擔我生活的點點滴滴。最後，我想將這篇論文獻給在去年離開我們的祖母。在這個夏天，終於我也能一起和爸爸，叔叔，還有哥哥，同樣在這個學期拿到碩士學位，希望您在世界的另一頭也能和我們一起分享這份喜悅。

魏士強 2005 年 仲夏 於交大