

國科會計畫

計畫編號: NSC97-2221-E018-025

研究期間: 9708-9807

可撓式有機電晶體臨界特性調變與摻雜技術研究  
The Study on the Threshold Characteristics Modification and Doping  
Technology in Flexible Organic Transistor

王右武

中文摘要

本計畫主要目的，在於研究可撓式有機薄膜電晶體在臨界區域的電光特性變化，影響因子，與物理意義，從而進行其特性調變技術的研究與開發，製作出符合軟性電子產業需求之高效能、高可靠度、高均勻度之電子元件。本計畫將分成三年度執行。第一年，著重在 OTFT 臨界區域之特性研究與分析，包括了基本的電光物理特性分析，諸如臨界電壓( $V_{th}$ )，開啟電壓( $V_{on}$ )，次臨界斜率(SS)，能態密度(DOS)，載子傳導機制等，在此區域的作用與定義。以及上述參數與有機半導體薄膜特性之關連性質研究，第二年，則將著重在，如何調變臨界特性的技術開發，包括進行有機半導體摻雜，介面處理層改質，閘極絕緣層調變，與元件結構的改變。第三年，則著重將開發出之新臨界特性調變技術應用於新穎之有機電子系統或顯示器上，其開發載具將鎖定為環型震盪器(Ring Oscillator)，以及 OTFT 驅動之 OLED 顯示器背板，此二者分別為軟性電子，與軟性顯示器之標竿技術，且 OTFT 之臨界特性對於其性能有特別重大之影響。計畫完成後，除產出相關論文與專利外，將能提供有機電子包括基礎理論與應用技術的完整研究，對於增進軟性電子產業與培育相關人才當有相當貢獻。

## Abstract

This project focuses on the study of the flexible organic thin film transistor (OTFT) threshold characteristics containing the physical meaning, definition, impact factors and even more the tuning technology. Eventually the high performance, high reliability, and high uniformity OTFTs would be produced for the flexible electronic industry. This is a project for three years. In the first year, we will focus on the basic research of the electric-optical and physical characteristics under the threshold regime for the flexible OTFT. The device parameters including the threshold voltage ( $V_{th}$ ), switch on voltage ( $V_{on}$ ), sub-threshold slop (SS), density of states (DOS) and the mechanism of carrier transport would be study in details, especially the physical meanings and definitions of these parameters. This study would be correlated with the research of the organic semiconductor thin film characteristics, such as the morphology (AFM), crystalline (XRD), interface states (CV) and surface binding energy (XPS, Kelvin Probe,...), etc... In the second year, the modification technology of OTFT threshold characteristics would be studied through several approaches. The thermal transfer nano-imprint technology would be introduced to the doping of organic semiconductor for tuning the threshold characteristics. Furthermore, the interface treatment and device configuration would also be verified to find out the rule of the change of threshold characteristics. In the third year, the previous result would be applied to smart organic electronics. The OTFT ring oscillator and OTFT-OLED backplane are the representatives of flexible organic electronics and flexible display, respectively. These two applications are very sensitive and critical to the OTFT threshold characteristics. The research point was focused on the fine tune and uniformity of area threshold characteristics. Finally, this project would produce some journal papers, patents and also provide a whole picture about the organic electronics theory and application technology. Further, improve the domestic related industry and educate the talented persons.