

# 有機半導體之傳輸性質

研究生:陳宜秀

指導教授:孟心飛

國立交通大學物理所



## 摘要

有機半導體是目前極受矚目的材質，因為具有高發光效益及傳輸性質，在元件設計與應用上有極高的價值。目前有機半導體在紅綠藍三原色的亮度均相當高，但元件的穩定度不夠，即半衰期太短。因此有許多科學家們致力於了解有機半導體傳輸機制，並且嘗試延長有機半導體的半衰期。

我們一開始由有機半導體的結構來解釋為什麼有機半導體極易受到破壞，進而影響傳輸與發光性質。由於有機半導體是藉由 $\pi$ 電子傳遞而導電，而 $\pi$ 電子的穩定性比 $\sigma$ 低， $\pi$ 電子本身易受外力作用而被旋轉扭曲，形成結構上的缺陷，除此以外， $\pi$ 電子還易受水、氧、光線影響而氧化變成共價鍵，造成整個元件效益大幅降低。

除此以外，我們亦探討不同結構及組成對於有機半導體的影響。同樣由碳、氫所組成卻擁有不同化學結構的有機半導體，在抗氧化、維持結構穩定亦有不同的表現。另外有機半導體在製作過程中，可能留下無法過濾乾淨的雜質，這些雜質的存在也同時影響傳輸效益，我們分別討論了這兩種缺陷對於載子遷移率 (carrier mobility) 的影響程度。

# The Transport Properties of Organic Materials

Student: Chen Yi-Shiou

Advisor: Prof. Hsin-Fei Meng

Institute of Physics National Chiao Tung University

## Abstract

Organic semiconductor is a popular synthetic material with high brightness and transport mobility. It is high valuable for electric device design and application. The organic light emitting diode is known to be a very attractive candidate for display, as well as other applications. Since Tang and VanSlyke reported on the organic light-emitting diodes (OLEDs), it has been widely studied by many researchers with the aim of developing it for commercial products. A short lifetime, low efficiency, and low stability, however, block the OLED and remain critical potential within commercial industries today.

The chemical structures of organic semiconductors are easier to be destroyed than traditional semiconductor (silicon devices). We believe this is the reason of unstable lifetime and transport of organic semiconductors. Because the transport carriers of organic semiconductor are  $\pi$  electrons which are easy to be twisted with force, the chemical structure will be changed and have some defects in the organic semiconductors. Beside, water, oxygen and light are also important factors for  $\pi$  orbital oxidization which is one way to decrease the stability of organic semiconductor.

We discuss the discrepancy of transport yield in different chemical structures and elements. It is interesting that organic semiconductors are constructed by carbon and hydrogen but their chemical stability and lifetime are diverse. In addition, there are some impurities, which can not be filtered completely in the synthetic process of organic semiconductor. Both structure defects and chemical impurities influence the transport yield. We discuss the mobilities of organic semiconductor by two kinds of defects.