

國立交通大學

電子工程學系 電子研究所碩士班

碩士論文

單一電子在 SONOS 快閃式記憶體中的現象，物理以及特性研究

**Single Charge Phenomena,
Characterizations and Physics**

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指導教授：汪大暉 博士

中華民國 九十九 年 七 月

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摘要

本篇論文是利用隨機電報雜訊(Random Telegraph Noise)來探討SONOS快閃式記憶體的特性。我們利用了隨機電報雜訊對通道電位很敏感的特性萃取出通道裡面的缺陷位置。利用通道裡面的缺陷位置，我們可以觀察出通道熱電子(Channel Hot Electron)的寫入電子的水平分布情形。

除此之外，我們也觀察到在 SONOS 裡寫入電子流失(Program Charge Retention Loss)的現象。這個現象在不同的研究裡有不同的模型來解釋。而我們藉由量測在寫入電子流失時電流的變化，推論出寫入電子流失是一種垂直的電子流失。根據其他研究顯示，隨機電報雜訊由於會受到通道路路徑影響，因此電流的改變是呈一種自然指數的分布。而因為寫入電子流失也是一種會受到通道路路徑影響的現象，因此我們也統計了電流在寫入電子流失現象下的電流曲線分布。

最後，我們建立了一個模組去了解在電子流失後臨界電壓(V_t)的分布情形，並且模擬出臨界電壓分佈尾端部分的變動。

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Abstract

In this thesis, random telegraph noise (RTN) method is used to inspect some properties in SONOS flash memory. The interface trap position is extracted since RTN is sensitive to the surface potential along channel. With the position of the trap, the channel hot electron (CHE) program charge lateral distribution is observed.

Besides, the phenomenon of program charge retention loss is observed. Different models have been used to explain this phenomenon. Since we measure the current fluctuation during charge loss, program charge loss can be concluded to vertical loss. According to other researches, RTN is a kind of percolation effect, and ΔV_t

distribution in RTN is exponential. Because program charge retention loss is also a kind of percolation effect, we measure the distribution of the current change in this phenomenon.

At last, a model is built to simulate the V_t distribution after program charge loss, and the tail bits of V_t distribution is also simulated.

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