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利用區域性應力通道提高電子遷移率之
n 型金氧半場效電晶體

**Strain Dependence of Mobility Enhancement in
Local Strained Channel nMOSFETs**

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指 導 教 授：趙天生 博士

中 華 民 國 九 十 三 年 六 月

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摘要

在本篇論文的研究中，我們利用控制電子通道中應力的技術來製作 n 型金氧半場效應電晶體，電子通道中應力的主要來源是利用在元件製作完成後覆蓋一層 SiN 薄膜，利用 SiN 薄膜本身具有的高應力特性來控制電子通道中應力的大小，進而達到改善電子遷移率的目的，我們可以經由控制不同厚度的 SiN 薄膜達到對電子遷移率不同程度的改善，另一方面，元件的起始電壓也可以經由改變 SiN 薄膜的厚度來做調整，增加元件的應用範圍。此外，我們利用非晶矽及複晶矽兩種堆疊的結構來製作元件的閘極，這種結構的優點主要是可以增加電子通道中應力的大小，使電子遷移率的增加幅度能夠更加顯著，我們發現同時利用閘極堆疊結構及在元件覆蓋 SiN 薄膜這兩種方式，可以有效提昇元件的電流驅動能力達 17%，我們相信利用控制電子通道中應力的大小來改善電流驅動能力在未來 CMOS 元件技術的發展上將扮演非常重要的角色。

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Abstract

A local strained channel nMOSFETs has been fabricated by a stress control technique utilizing a strained poly silicon gate. It utilizes heavy mechanical stress produced by SiN-capping layer. We experimentally demonstrate the improvement of current drivability of nMOSFETs with control the stress to the channel region. The drain current is improved 17% compared to that of the conventional devices. The current drivability can be enhanced by controlling the thickness of SiN-capping layer. We believe that the performance changes are caused by changes of the electron mobility. We also demonstrated the threshold voltage can be tunable with different thickness of the SiN layer. Moreover, the stack of amorphous and poly silicon gate is estimated to increase the strain in the channel region more than the single-poly-silicon gate structure. We found that the strain dependence of mobility enhancement will become significant by using both SiN-capping layer and stack of amorphous silicon gate structures.

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