論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	A study on Semiconductor Interfaces with Rare Earth Oxide and Ni Silicides for High Performance InGaAs MOSFETs
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Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

専攻： Department of	物理電子システム創造　専攻	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of　（　工学　）
学籍番号： Student ID Number		指導教員（主）： Academic Advisor(main)	岩井　洋
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要旨（英文 300 語程度）
Thesis Summary（approx.300 English Words ）

This thesis focuses on investigating La2O3 as a gate dielectric with great potential for InGaAs-based gate stacks. The majority of work in various research groups has been conducted on application of HfO2 and Al2O3 to InGaAs. The issues regarding both of these materials were described in section 2.3, however in this thesis the fundamental difficulties of HfO2/InGaAs are evaluated under a new proposal. Therefore, the general purpose of this thesis is to improve the high-k/InGaAs interface properties, by introducing a new approach for fabricating reactive high-k/InGaAs interface through the application of La2O3 as high-k gate dielectric.

This thesis consists of eight chapters. Chapter 1 describes the background of MOSFET scaling history and the emergence of new channel material with higher carrier transport properties, such as III-V compound semiconductors and in particular InGaAs. Chapter 2 states the history and current status of III-V based devices and the issues facing the commercial application of such devices with a focus on gate-stack technology as the main determinant for device success. The common experimental scheme used throughout this study, is described in Chapter 3. In Chapter 4, properties of HfO2/InGaAs interface is investigated and a temperature manipulation method during HfO2 deposition is proposed to compensate the formation of defects at the bulk of InGaAs. Chapter 5 focuses on applying La2O3 as a gate dielectric to InGaAs substrate and is divided to four sections. The first section describes the difference between the reactivity of La2O3 and HfO2 with InGaAs. Formation of LaInGaOx layer at La2O3/InGaAs interface is proposed and the issues that need to be resolved in order to improve La2O3/InGaAs electrical properties are described. The following section purposes a novel passivation method of InGaAs surface, based on self-assembled monolayer formation of Si-containing elements to improve the electrical properties of La2O3/InGaAs interface. The third section describes the application of La-silicate structure on InGaAs. Excellent thermal stability of silicate structures was utilized for to manufacture gate stacks with Capacitance Equivalent Thickness (CET) of 0.7 nm which correspond to an EOT< 0.5 nm considering the quantum effects. In the final chapter, the reaction between La2O3 and InGaAs was controlled by controlling the amount of oxygen diffusion through the choice of metal gate. Compositional and thickness control of the resultant interfacial layer yielded one of the lowest Dit levels in the literature even compared to that of Al2O3/InGaAs interface. Chapter 6 deals with requirements for future node 3D structure devices on InGaAs platforms and purposes solutions for two of the critical obstacles (gate stack and source/drain regions). The chapter is divided to two sections, each section dealing with gate stack and source-drain regions separately. The first section describes synthesizing La2O3 film by Atomic Layer Deposition (ALD) method, the second section offers a novel stacked Ni/Si structure for forming highly stable NiSi2/InGaAs without forming any alloy at the interface. In chapter 7, InGaAs MOSFET operation with La2O3 as high-k gate dielectric and Ni/InGaAs as metal source and drain is demonstrated. The conclusions and prospects for future work are stated in Chapter 8.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 2 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 2 copies of 800 Words (English).