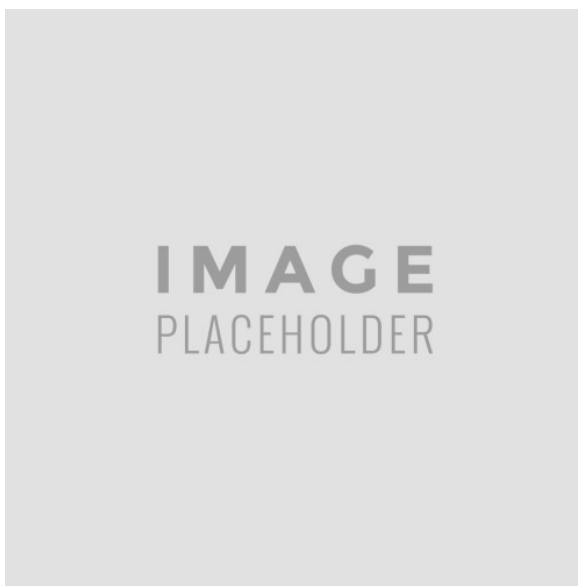


MONASH UNIVERSITY

HONOURS THESIS

# Thin oxides in graphene devices



---

Supervisors:

Michael Fuhrer  
Semonti Bhattacharyya

---

Physics Honours, Monash University  
Student ID: 24121843

## **Abstract:**

I present a review of the use of graphene in electronic devices, both in its shortfalls and exciting properties. The electronic structure is detailed, along with various scattering sources that affect electron transport and ultimately the goal of room temperature, electronic devices. Considering heterostructures and the use of other materials to enhance graphene, I discuss the potential use of hafnium dioxide, and other oxides, as an excellent gate dielectric material for potential use in graphene field-effect devices.

# Contents

0.1 Foreword . . . . .	1
<b>1 Introduction</b>	<b>2</b>
<b>2 Production &amp; identification of graphene</b>	<b>3</b>
2.1 Identification of Graphene . . . . .	3
<b>3 Device characterisation</b>	<b>4</b>
<b>4 Device fabrication techniques</b>	<b>5</b>
<b>5 CVD graphene</b>	<b>6</b>
<b>6 Exfoliated graphene</b>	<b>7</b>
<b>7 References</b>	<b>8</b>

## 0.1 Foreword

This thesis serves the purpose presenting the conclusions of my research into thin oxides on graphene. I will be arguing why I have come to the conclusions I have, and how that fits into a bigger picture of materials science and particular applications.

In chapter 1, I will outline what I hope to achieve in this project. I begin by discussing the theoretical properties of graphene and why it has attracted so much interest as an electronic material. I will also describe some challenges facing new computing technologies, including the use of dielectrics, and how my work contributes to realising solutions to new generations of this technology. I will outline a theoretical and experimental summary of the results to date seen in introducing dielectrics to graphene.

In chapter 2, I describe the various ways of producing and identifying graphene in lab use, and the characterisations I have conducted. This will include our use of atomic force microscopy (AFM), optical microscopy and Raman spectroscopy.

I will then describe the devices and measurements I have made in chapter 3. This will particularly regard geometry and connections to devices, which allow the measurements I have perform.

This will motivate my description of the processes used to fabricate our devices in 4. I have made graphene devices using lithography and evaporation methods, to create electrical contacts. I will also describe the oxides I have investigated in this chapter, and the methods I have used to transfer them.

In chapter 5 and chapter 6, I will present the data and results from my measurements of the respective devices, analysing the effects of oxides before and after stamping.

## Chapter 1

# Introduction

## Chapter 2

# Production & identification of graphene

### 2.1 Identification of Graphene

## Chapter 3

# Device characterisation

## Chapter 4

# Device fabrication techniques

## Chapter 5

# CVD graphene

## Chapter 6

# Exfoliated graphene



## Chapter 7

## References