

MASTER'S THESIS

A study on the composition and deposition mechanism of boron-silicon alloy films using ICP-AES, EDX and FT-IR techniques

Leu, Chun Lun Alan

Date of Award:
1991

[Link to publication](#)

General rights

Copyright and intellectual property rights for the publications made accessible in HKBU Scholars are retained by the authors and/or other copyright owners. In addition to the restrictions prescribed by the Copyright Ordinance of Hong Kong, all users and readers must also observe the following terms of use:

- Users may download and print one copy of any publication from HKBU Scholars for the purpose of private study or research
- Users cannot further distribute the material or use it for any profit-making activity or commercial gain
- To share publications in HKBU Scholars with others, users are welcome to freely distribute the permanent URL assigned to the publication

A study on the
composition and deposition mechanism
of
boron-silicon alloy films
using
ICP-AES, EDX and FT-IR techniques

Leu Chun-lun, Alan

A thesis submitted in partial fulfillment
of the requirements for the
degree of Master of Philosophy

September, 1991.

Hong Kong Baptist College
Hong Kong



Gf
10-6-92
266550

TH
M. PHIL
1991LS

ii

ABSTRACT

Boron doped silicon films deposited at different substrate temperatures and at different gas ratio between diborane and silane gases were studied. Inductively coupled plasma atomic emission spectroscopy (ICP-AES) and energy dispersive x-ray spectroscopy (EDX) and Fourier transform infrared spectroscopy (FT-IR) experiments were carried out to study how the composition of the films depend on the substrate temperature and gas ratio of the reactants. The results showed that the silicon and boron contents of the films were affected by the partial pressures of silane and diborane gases and the substrate temperature during film growing. Also, it was found that the boron to silicon ratio in the film was close to that of the reactants gases when the film grew at low partial pressure of diborane gas, whatever the substrate temperature was. Furthermore, it was found that when the partial pressure of diborane gas was much higher than that of silane gas, the boron content in the film was found to increase much slower than it was expected, in agreement with Giling's suggestion of condensation of diborane molecules at high pressure of diborane gas. Results from Fourier transform infrared spectroscopy (FT-IR) experiments also showed the same result.

TABLE OF CONTENTS

ABSTRACT	
DECLARATION	
ACKNOWLEDGEMENTS	
CHAPTER 1. INTRODUCTION.....	1
CHAPTER 2. BASIC THEORY	6
2.1 LOW PRESSURE CHEMICAL VAPOR DEPOSITION	6
2.1.1 BASIC SETUP OF A CVD SYSTEM.....	9
2.2 ICP-AES SPECTROMETER	12
2.2.1 INDUCTIVELY COUPLED PLASMA	14
2.2.2 DOUBLE MONOCHROMATOR.....	19
2.2.3 COMPUTER AND CONTROL PROGRAM	20
2.2.4 ADVANTAGES OF ICP-AES	21
2.2.5 DETECTION LIMITS	22
2.3 ENERGY DISPERSIVE X-RAY SPECTROMETER	23
2.3.1 PRINCIPLE OF THE ENERGY DISPERSIVE SYSTEM	24
2.3.2 COMPOSITION DETERMINATION	27
2.3.2.1 APPARENT CONCENTRATION	31
2.3.2.2 ZAF CORRECTIONS	32
2.4 FOURIER TRANSFORM INFRARED SPECTROMETER	38
2.4.1 INFRARED ABSORPTION OF A MATTER.....	39
2.4.2 BASIC THEORY OF THE MICHELSON INTERFEROMETER.....	40
2.4.3 HELIUM-NEON LASER.....	42
2.4.4 TRANSFORMING THE INTERFEROGRAM INTO A SPECTRUM.....	42

2.4.5 TRANSMISSION SPECTRUM OF THE SAMPLES.....	45
CHAPTER 3. EXPERIMENTAL	47
3.1 DESCRIPTION OF SAMPLES	47
3.2 EXPERIMENTAL PROCEDURE	53
3.2.1 MEASURING THE SAMPLE COMPOSITION BY ICP-AES.....	53
3.2.1.1 SAMPLE PREPARATION	53
3.2.1.2 ICP-AES SPECTROMETER EXPERIMENT.....	61
3.2.2 EDX EXPERIMENT.....	64
3.2.2.1 SAMPLE PREPARATION FOR EDX	64
3.2.2.2 EDX EXPERIMENT.....	65
3.2.3 FT-IR SPECTROMETER.....	71
3.2.3.1 SAMPLES PREPARATION FROM FT-IR.....	71
3.2.3.2 SPECTRUM COLLECTION	72
CHAPTER 4. RESULTS AND DISCUSSIONS.....	75
4.1 ICP-AES.....	75
4.2 EDX.....	85
4.3 FT-IR	94
4.4 DEPOSITION MECHANISM	105
CHAPTER 5. CONCLUSION	114
REFERENCES.....	116
VITA.....	119