

Contents

Foreword — VII

Chapter 1

Introduction — 1

- 1.1 Atomic layer deposition — 1
- 1.2 Precursor — 2
- 1.3 Adsorption — 2
- 1.4 Surface vs. substrate — 2
- 1.5 Monolayer — 3
- 1.6 Self-limiting — 3
- 1.7 Layer-by-layer growth — 3
- 1.8 Atomic layer deposition history — 5
- 1.9 Trimethyl aluminum and water — 8
- 1.10 Helpful resources — 11

Chapter 2

Saturation — 13

- 2.1 The saturation curve — 18
- 2.2 Selectivity and saturation — 23
- 2.3 Steric bulk and saturation — 23
- 2.4 Selectivity — 24

Chapter 3

Ligands — 27

- 3.1 Ligand bonding — 27

Chapter 4

Precursors — 37

- 4.1 Atmospheric sensitivity — 38
- 4.2 Halide precursors — 40
- 4.3 Alkyl precursors — 41
- 4.4 General synthetic reactions — 41
- 4.5 Designing precursors — 43
- 4.6 Volatility — 43
- 4.7 Thermal stability — 45
- 4.8 Reactivity — 50

Chapter 5

Thermolysis — 53

- 5.1 Definitions of thermal onset temperatures — **53**
- 5.2 Thermogravimetry — **54**
- 5.3 Differential scanning calorimetry — **58**
- 5.4 Thermal range and figure of merit — **60**
- 5.5 Decomposition testing — **61**
- 5.6 Volatility control — **63**
- 5.7 Impurity control — **64**

Chapter 6

Nucleation — 65

- 6.1 Protonated surface nucleation sites — **66**
- 6.2 Metal surface nucleation sites — **68**
- 6.3 Hydride surfaces — **69**
- 6.4 Surface blocking groups and selective area deposition — **70**

Chapter 7

ALD processes — 73

- 7.1 Alumina deposition — **73**
- 7.2 Titanium nitride deposition — **77**
- 7.3 Copper metal deposition — **79**
- 7.4 Gold metal deposition — **81**
- 7.5 Tin oxide deposition — **82**

Chapter 8

MLD processes — 85

- 8.1 Alucone deposition — **85**
- 8.1.1 Bifunctional monomers — **86**
- 8.2 Tetracyanoethylene deposition — **88**
- 8.3 Alq₃ deposition — **89**
- 8.4 Kevlar deposition — **90**
- 8.5 PEDOT deposition — **92**

Chapter 9

ALE processes — 95

- 9.1 Etching oxides — **96**
- 9.2 Etching metals — **98**

Index — 103