

論文 / 著書情報  
Article / Book Information

題目(和文)	導電性材料のマイクロ接合における固相反応による組織形成挙動
Title(English)	Microstructure evolution due to solid-state reaction at micro-bonding of conductor materials
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出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第9427号, 授与年月日:2014年3月26日, 学位の種別:課程博士, 審査員:梶原 正憲,河村 憲一,里 達雄,小林 郁夫,木村 好里
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第9427号, Conferred date:2014/3/26, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	要約
Type(English)	Outline

(博士課程)

Doctoral Program

## 論文の要約

THESIS OUTLINE

専攻 :	材料工学	専攻	申請学位 (専攻分野) :	博士 (工学)
Department of			Academic Degree Requested	Doctor of
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Various interconnecting methods between dissimilar metals such as wire bonding and microbumping are used in electronic devices. Intermetallic compounds and fine voids may be formed under usual energization conditions at the interconnection. The formation of intermetallic compounds and voids deteriorates mechanical and electrical properties of the interconnection. This causes potential reliability issues and failures of electronic devices. In order to prevent the serious problem, the formation of intermetallic compounds and voids should be suppressed by appropriate artifices. For the establishment of such artifices, kinetics of solid-state reactive diffusion and the formation of Kirkendall voids due to different intrinsic diffusion coefficients at the interconnections between dissimilar metals were experimentally and theoretically investigated in the present study. Contents of thesis are shown in following tables.

### Chapter 1. Introduction

- 1.1. Various interconnections in electronic package process
- 1.2. Kinetics of solid-state reactive diffusion at the interface of the interconnection
- 1.3. Kirkendall voids in metallic systems

### Chapter 2. Reactive Diffusion in the Cu/Al System

- 2.1. Introduction
- 2.2. Experimental procedures
- 2.3. Results and discussion
  - 2.3.1. Microstructure
  - 2.3.2. Growth behavior of intermetallic layer
  - 2.3.3. Rate-controlling process
- 2.4. Conclusions

### Chapter 3. Reactive Diffusion in the Au/Al System

- 3.1. Introduction
- 3.2. Experimental procedures
- 3.3. Results and discussion
  - 3.3.1. Microstructure
  - 3.3.2. Growth behavior of intermetallic layer
  - 3.3.3. Transition of rate-controlling process
- 3.4. Conclusions

#### Chapter 4. Reactive Diffusion in the Ag/Al System

- 4.1. Introduction
- 4.2. Experimental procedures
- 4.3. Results and discussion
  - 4.3.1. Microstructure
  - 4.3.2. Growth behavior of intermediate layer
  - 4.3.3. Rate-controlling process
- 4.4. Conclusions

#### Chapter 5. Microstructure Evolution of Intermediate Phases in the Ag/Al System

- 5.1. Introduction
- 5.2. Experimental procedures
  - 5.2.1. Preparation of diffusion couple
  - 5.2.2. Observation methods
- 5.3. Results and discussion
  - 5.3.1. Examination by DICOM and EPMA
  - 5.3.2. Observation by HVEM
  - 5.3.3. Crystal structure
  - 5.3.4. Evolution of precipitates and phase growth
- 5.4. Conclusions

#### Chapter 6. Reactive Diffusion in the Co/Sn System

- 6.1. Introduction
- 6.2. Experimental procedures
- 6.3. Results and discussion
  - 6.3.1. Microstructure
  - 6.3.2. Growth behavior of intermetallic layer

6.3.3. Rate-controlling process

6.4. Conclusions

## Chapter 7. Reactive Diffusion in Microbump Metallurgy Systems

7.1. Introduction

7.2. Experimental procedures

7.3. Results and discussion

7.3.1. Cu/(Sn-0.7Cu)

7.3.1.1. Microstructure

7.3.1.2. Growth behavior of intermetallic layer

7.3.2. Co/(Sn-0.7Cu)

7.3.2.1. Microstructure

7.3.3.2. Growth behavior of intermetallic layer and dissolution rate of Co

7.4. Conclusions

## Chapter 8. Analysis of Kinetics for Kirkendall Effect in Binary Metallic Systems

8.1. Introduction

8.2. Binary Cu-Sn system

8.2.1. Analytical model

8.2.2. Experimental observation methods of Kirkendall voids

8.2.3. Results and discussion

8.2.3.1. Simulation

8.2.3.2. Experimental observation

8.3. Binary Ni-W system

8.3.1. Kinetic model

8.3.2. Results and discussion

8.3.2.1. Analytical calculation

8.3.2.2. Observation

8.4. Conclusions

## Chapter 9. General Conclusions