课程大纲
COURSE SYLLABUS

1.	课程代码/名称 **Course Code/Title**	**Failure Mechanisms of Polymers in Microelectronic Packages** **电子封装结构中的高分子材料失效行为**
2.	课程性质 **Compulsory/Elective**	专业选修课/Elective
3.	课程学分/学时 **Course Credit/Hours**	3/64
4.	授课语言 **Teaching Language**	英语/English
5.	授课教师 **Instructor(s)**	王珂，薛珂 Ke Wang, Xue Ke
6.	先修要求 **Pre-requisites**	无/NA

7. 教学目标
Course Objectives

1. To provide the students with a basic understanding of the roles that polymer materials playing in the microelectronic and microsystem packages (e-package) and its importance in product design.
2. To provide the students with an understanding on physical and chemical properties of polymer materials that are critical in e-package reliability.
3. To introduce the concept of material selection and design for assembly and manufacturing of e-packages.
4. To introduce the failure behaviors and mechanisms of e-packages due to polymer materials failure.
5. To introduce the characterization and simulation tools that are used in e-package design and reliability assessment
6. To provide students with basic knowledge on the industry size of e-package manufacturing and the understanding the controlling factors that detecting the quality of massive production in reality

8. 教学方法
Teaching Methods

理论和实验/Lecture and Lab

9. 教学内容
Course Contents

Section 1

- Review of basic concepts
  - ▪ Molecular and morphological structure of polymers
  - o Classification of polymers
  - o Amorphous and crystalline polymers
  - o Viscoelasticity of polymeric materials
  - o Physical properties of polymers (T_m, T_g and T_d)
  - o Characterization techniques for physical properties
  - ▪ Fracture mechanics
  - o Stress, strain and stress-strain relationship
  - o Stress concentration
  - o Plane stress and plane strain
  - o Elastic deformation and plastic deformation
- o Fracture toughness

Section 2

- Deformation mechanisms in polymers

		• Shear yielding • Crazing • Cracking
	Section 3	• Fractography of polymers • Optical microscopic analysis • Scanning electron microscopic analysis • Transmission electron microscopic analysis • Other techniques
	Section 4	• Functions of Electronic Packaging ▪ Role of Packaging in Microelectronics ▪ Role of Packaging in Microsystems
	Section 5	• Packaging Materials and Processes ▪ Role of Packaging Materials ▪ Packaging Materials and Properties ▪ Packaging Materials Processing
	Section 6	• Design for Environment and Reliability ▪ Physics-based Failure Analysis ▪ Stress Analysis and Failure Criteria ▪ Role of Computational Simulation
	Section 7	• Package Level and Board Level Reliability Tests ▪ Strength of Interconnects ▪ Tests for Moisture Sensitivity ▪ Tests for Thermal Aging ▪ Design of Experiments ▪ Temperature Cycling Tests ▪ Mechanical Tests
	Section 8	• Fundamentals of Electrical & Thermal Analysis ▪ Cooling Requirements ▪ Thermal Management
	Section 9	• Case study

10. **课程考核**
Course Assessment

请再此注明：①考查/考试；②分数构成。

- Midterm Exam (Open Book): 20%
- Project report (two reports) 30%
- Presentation (Individual) 50%

11. **教材及其它参考资料**
Textbook and Supplementary Readings

Fracture Behaviour of Polymers，A.J. Kinloch and R.J. Young

Fundamentals of Microsystems Packaging，R. Tummala, ed.,

Advanced Electronic Packaging，Richard K. Ulrich and William D. Brown