MSE 6510 - Polymers for Electronic Packaging Applications I
Course Outline

Lecturer: C.P. Wong, Regents' Professor and Charles Smithgall Institute Endowed Chair

Learning Objectives:

Through the application of fundamental and principles of polymers, this course will provide a concise, yet comprehensive overview of the intimate relationships between polymers in electronic applications. The students will be introduced to the latest advances in the semiconductor technology and an appreciation of the importance of polymers in advancing the modern microelectronics.

Catalog Description:

Credit (3-0-3)
Prerequisites: Basic foundation in chemistry, physics and electronics is preferred. Introduction to Polymer Engineering or similar course would be helpful.

This course will review the fundamentals and principles of polymers used in electronic and photonic applications. The relationships between the advances of semiconductor technology and the importance of polymers and their applications will be discussed.

Proposed Syllabus:

Textbooks &: References

1. C. P. Wong, Ed., "Polymers for Electronic and Photonic Applications," Academic Press (1993).
2. J. Lau, C. P. Wong, J. Prince, W. Nakayama, "Electronic Packaging: Design, Materials, Process and Reliability", McGraw Hill, NY, (1998).
3. R. Tummala, et al., Ed., "Fundamentals of Microsystems Packaging", McGraw Hill (2001).
4. C. P. Wong, K. S. Moon, Ed., "Nano-Bio-Electronic, Photonic and MEMS Packaging", Springer, Second Edition (2021).
5. D. Lu, C. P. Wong, Ed., "Materials for Advanced Packaging", Springer, Second Edition (2017)

Course Contents:

Introduction & Overview of Semiconductor Packaging Technology (2-3 Lectures) Past, Present and Future, and their Economic Technological and Trends

Purpose of Electronic Packaging, Interconnects and Material Needs (1-2 lectures)

Overview: Fundamentals and Principles of General, Organic and Polymer Chemistry (2-3 Lectures)

Electronic Interconnects Levels and Process Techniques (3-4 Lectures)
Wire-bonding, Flip-chip, Tap Automated Bonding (TAB), Beam-leaded, Polymer Interconnect, Ball Grid Array (BGA), Chip Size/Scale Packaging (CSP), FC, etc.

Inorganic Polymers as IC Passivation and Interlayer Dielectric Materials (2 Lectures)
Thermal CVD, Plasma Processes and Plasma Enhanced CVD

High Performance Organic Polymers for Electronic Coating and Passivation (6-7 Lectures)
Silicones, Epoxies, Polyimides, Silicone-Polyimides, Parylenes, BCB, Silicon-carbons, Polyesters, Low K, High performance thermoplastics and Liquid-crystal Polymers, Conductive Adhesives(ICA, ACA/F for lead-free Interconnects).

Prepackaging Cleaning and Control Methods (2 lectures)
Interfacial Surface Analyses, Contact Angle, XPS, Electronic Corrosion Mechanism and Lotus Effect Materials

Microelectronic Encapsulation Techniques and Thermal Stress Analyses of Packaging (4-5 Lectures)
Coatings, Moldings, Potting, Chip-on-Board, Glob-tops, over-molded, BDA, CSP and Flip-chip Underfills.

Reliability Testing of Polymers: (2-3 lectures)
Fundamental of the Reliability Physics, Test Setup and Data Interpretation

Photonic Packaging (1 lectures)
The fundamentals and Recent Advances

MATE 6510 MSE
Spring 2024

TERM PAPER

Length – 12 to 18 pages, double-spaced (font size 12) plus references, figures, tables.

Level – Assume you are writing an article for a technical journal reviewing a particular area of technology. (Be concise)

Topics –

TBA

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Grading Criteria for Term Paper

a. **Literature survey, US Patents**, focus and complete coverage;
b. Insight into technology area chosen: **latest development**;
c. Ability to synthesize material form diverse sources;
d. Quality of reference materials: (Literature survey, US Patent, etc.);
e. Relationship to future technology trends (your insights…).

Important Dates

1/25 – Topic, outline and references are due.
4/11 – Final term paper is due (or before).

Course Grade : 1/3 or each- Midterm Exam, Final Exam and Term Paper.

MSE 6510: Class Schedule (Spring 2024)

Week	1	1/9	1/11
	2	1/16	1/18
	3	1/23	1/25 Paper Topic Due
	4	1/30	2/1
	5	2/6	2/8
	6	2/13	2/15
	7	2/20	2/22
	8	2/27 Midterm Exam	2/29
	9	3/5	3/7
	10	3/12	3/14
	11	3/19 Spring Break	3/21 Spring Break – Work on Term Paper
	12	3/26	3/28
	13	4/2	4/4
	14	4/9	4/11 Final Paper Due
	15	4/16	4/18 Final Exam