Program Specification: Master of Electrical and Microsystems Engineering

V9E: Advanced Semiconductor Technology

Learning Objectives:

- Describe methods for fabricating nanoparticles, nanotubes, nanowires, and nanostructured thin films.
- Compare the physical properties of nanomaterials.
- Application of tools for structure and property characterization of nanostructures.
- Assess the applications for nanomaterials for various industries

Previous Experience/Premise

text

Content:

Topic 1: Introduction to Nanomaterials: An Introduction
1.1 Introduction to nanoscale materials
1.2 Overview, definitions, example
1.3 Top-down and Bottom Up approaches
1.4 Advances in Nanomaterials

Topic 2: Synthesis of Nanoparticles
2.1 Nanoparticles
2.2 Nanowires
2.3 Nanotubes
2.4 Thin Films
2.5 Case Study: Metal Nanoparticles Fundamentals and Application

Topic 3: Synthesis of Nanoparticles Part 2
2.1 Ceramic Nanomaterials: Fundamentals and Applications
2.2 Fullerenes and Carbon Nanotubes and Nanofibers: Fundamentals and Application
2.3 Semiconductor Quantum Dots: Fundamental and Applications

Topic 3: Characterization
3.1 X-Ray Diffraction
3.2 Electron Microscopies
3.3 High Resolution Transmission Microscopy
3.4 Raman Spectroscopy
3.5 Rheological Characterisation

Topic 4: Flow Behaviour of Nanoparticles
4.1 Fundamentals of Rheology
4.2 Introduction to Suspension Rheology
4.2 Rheometer
4.3 Rheological Test Methods
4.4 Case Study: Rheological Characterisation of Silver Based Conductive Adhesives

Topic 5: Graphene and Applications
5.1 Introduction to Graphene
5.2 Synthesis of Graphene
5.2 Application of Graphene

Topic 6: Nanomaterials in Electronic Packaging Industry
6.1 Introduction to Electronic Packaging Materials
6.2 Bonding Materials: Solder Paste and Isotropic Conductive Adhesives
6.3 Processability of Bonding Materials
6.4 Challenges

Topic 5: Case Study
Case Study 1: Development of Low Temperature Sintering Bonding Material
Case Study 2: Antibacterial Effect of Silver Nanoparticles
Case Study 3: Development of Graphene Based Isotropic Conductive Adhesives

Literature:
- Dieter Vollath, Nanomaterials: An Introduction to Synthesis, Properties and Applications 2nd Edition

Duration:
1 week

Assessment: Written exam (45 minutes)

Teaching session: Seminar, Block session during semester break

Duration: 2 SWS

Credit Points: 2 CP

Evidence of Academic Achievement:
14 weeks x 1 hour estimated weekly unsupervised follow-up study, 20 hours seminar work, 10 hours preparation for presentation, 20 hours for written report, total 64 hours

Lecturer: Prof.Ir.Dr. Rajkumar Durairaj, PhD (UK), BEng (Hons) (UK), CEng, MI MechE

Special Note:
Part of the module Advanced Semiconductor Technology. Only if you have enrolled and successfully passed two sub-modules of the module “Advanced Semiconductor Technology”, you will be awarded a grade for Advanced Semiconductor Technology.