

Processing and Packaging Technologies for Photonic Integration (E030450)

Cursusomvang *(nominale waarden; effectieve waarden kunnen verschillen per opleiding)*

Studiepunten 4.0

Studietijd 120 u

Aanbodssessies in academiejaar 2026-2027

A (semester 2)

Engels

Gent

Lesgevers in academiejaar 2026-2027

Van Steenberge, Geert

TW06

Verantwoordelijk lesgever

Missinne, Jeroen

TW06

Medelesgever

Aangeboden in onderstaande opleidingen in 2026-2027

[Master of Science in Silicon Photonics](#)

stptn

aanbodssessie

4

A

Onderwijstalen

Engels

Trefwoorden

Semiconductor technologies, packaging

Situering

Expose the students to various fabrication and packaging concepts necessary for PICs

Inhoud

Introduction

iSiPP50G Silicon Photonics Platform

Semiconductor Technologies

Crystal Growth

Silicon Crystal Growth from the Melt

Starting Material

The Czochralski Technique

Distribution of Dopant

Silicon float-zone process

Material Characterization

Wafer Shaping

Crystal Characterization

Silicon Oxidation

Thermal Oxidation Process

Impurity Redistribution During Oxidation

Masking Properties of Silicon Dioxide

Oxide Quality

Oxide Thickness Characterization

Photolithography

Optical Lithography

The Clean Room

Exposure Tools

Masks

Photoresist

Pattern Transfer

Resolution

Next-Generation Lithography Methods

Electron Beam Lithography

Extreme Ultraviolet Lithography

- Etching
 - Wet Chemical Etching
 - Silicon Etching
 - Silicon Dioxide Etching
 - Silicon Nitride Etching
 - Aluminum Etching
 - Dry Etching
 - Plasma Fundamentals
- Etch Mechanism
- Plasma Diagnostics
- End-Point Control
- Reactive Plasma Etching Applications
- Diffusion
 - Basic Diffusion Process
 - Diffusion Equation
- Diffusion Profiles
 - Extrinsic Diffusion
- Ion Implantation
 - Range of Implanted Ions
 - Ion Distribution
- Ion Stopping
- Ion Channeling
 - Implant Damage and Annealing
- Film Deposition
 - Epitaxial Growth Techniques
 - Chemical Vapor Deposition
- Molecular Beam Epitaxy
 - Structures and Defects in Epitaxial Layers
 - Lattice-Matched and Strained-Layer Epitaxy
- Defects in Epitaxial Layers
 - Dielectric Deposition
 - Silicon Dioxide
- Silicon Nitride
 - Metallization
 - Physical Vapor Deposition
- Chemical Vapor Deposition
- Aluminum Metallization
 - Copper Metallization
- Fabrication of Silicon Waveguide Devices
- Silicon-on-Insulator
 - Separation by Implanted Oxygen (SIMOX)
 - Bond and Etch-Back SOI
 - Wafer Splitting
- Selected Components from iSiPP50G Silicon Photonics Platform
 - Silicon Waveguides
- Modulators
- Photodiodes
- Grating couplers
- Packaging Technologies**
- Optical Packaging
 - Fiber-Coupling
 - Grating-Coupling
 - Edge-Coupling
 - Fiber-Array Attach
- V-groove Integration
- Laser Integration
 - Micro-Packaged Lasers
 - Die Bonding
 - Flip-Chip Bonding
 - Transfer Printing
- Micro-Optics Integration
 - 3D Nano-Printing
- High-accuracy Pick-and-Place

- Monolithic Micro-Optics Integration
- Electrical Packaging
- Wire Bonding
- Flip-Chip Bumping and Bonding
- Hybrid Bonding
- Wafer-Level Packaging
 - 2D Integration Using Organic Interposers
- 2.5D Integration Using Silicon Interposers with TSVs
- 3D Integration
- Fanout Wafer-Level Packaging
- Micro-Chiplets
- Thermal Packaging
 - Thermal Interface Materials
 - Thermo-Electric Cooling

Begincompetenties

Basic optics and electromagnetics

Eindcompetenties

- 1 Understanding of different semiconductor process steps like crystal growth, oxidation, photolithography, etching, diffusion, ion implantation, and film deposition
- 2 Understanding of the fabrication of the most important integrated photonics components
- 3 Understanding of different photonics packaging processes like fiber array attach; laser integration, micro-optics integration, wire and flip-chip bonding, wafer-level packaging, thermal packaging.
- 4 Critical reading and understanding of a scientific article
- 5 Hands-on experience with a number of process steps in a clean room environment.
- 6 Development of a custom PIC package

Creditcontractvoorwaarde

Toelating tot dit opleidingsonderdeel via creditcontract is mogelijk na gunstige beoordeling van de competenties

Examencontractvoorwaarde

Dit opleidingsonderdeel kan niet via examencontract gevolgd worden

Didactische werkvormen

Hoorcollege, Practicum, Zelfstandig werk

Toelichtingen bij de didactische werkvormen

Lectures, cleanroom project, independent work

Studiemateriaal

Type: Slides

Naam: Slides and course notes used during the course

Richtprijs: Gratis of betaald door opleiding

Optioneel: nee

Bijkomende info: Available electronically (free)

Referenties

- [1] May, Gary S.; Sze, Simon M. Fundamentals of Semiconductor Fabrication, John Wiley and Sons, 2004.
- [2] C.Y. Chang and S.M. Sze. ULSI Technology, McGraw-Hill, 1996.
- [3] C.Y. Chang and S.M. Sze. ULSI Devices, John Wiley and Sons, 2000.
- [4] S.M. Sze. VLSI Technology, McGraw-Hill, 1988.
- [5] H. Zimmermann. Silicon Optoelectronic Integrated Circuits, Springer, 2004.

Vakinhoudelijke studiebegeleiding

4 wetenschappelijke medewerkers

Evaluatiemomenten

periodegebonden en niet-periodegebonden evaluatie

Evaluatievormen bij periodegebonden evaluatie in de eerste examenperiode

Mondelinge evaluatie

Evaluatievormen bij periodegebonden evaluatie in de tweede examenperiode

Mondelinge evaluatie

Evaluatievormen bij niet-periodegebonden evaluatie

Mondelinge evaluatie

Tweede examenkans in geval van niet-periodegebonden evaluatie

Examen in de tweede examenperiode is enkel mogelijk in gewijzigde vorm

Toelichtingen bij de evaluatievormen

- During examination period: oral closed-book assessment.
- During semester: periodic and permanent evaluation. Presentation about a project focusing on fabrication and packaging

Eindscoreberekening

70% oral exam, 30% presentation.