PhotonHub Experience Centre

Course 01
Photonics Packaging & Integration Technologies

Course Provider

Tyndall Institute
University College Cork
Ireland

Course Overview

Photonic device packaging can account for over 50% of the photonic product manufacturing cost. Therefore, it is vital that industries developing photonic-based products have an understanding of the materials, technologies and processes required to package their photonic devices.

This 3-day training course provides industry, especially those involved in photonic product development, with the fundamental technical skills in package design, assembly and reliability analysis. The course covers the key optical, electrical, thermal and mechanical aspects of packaging technologies. It also provides an overview of packaging equipment and reliability factors which are critical parts of the total manufacturing ecosystem.

This unique industry ‘hands-on’ training programme provides attendees with access to state-of-the-art facilities, materials and equipment, with dedicated tutorials and mentoring for technical experts.

Target Audience

It is desirable but not essential that course attendees have a basic understanding of photonics. The course is ideally suited to those planning to develop new photonic products, establish in-house or outsource packaging development and manufacturing.

Expected Outcomes

1) Perform key photonic packaging processes and use advanced packaging equipment
2) Perform photonic module test, reliability and failure analysis
3) Learn about critical photonic packaging design rules
4) Learn how to manage the photonic product design process and manufacturing ecosystem

Course Equipment & Infrastructure

Course Schedule

Day & Time	Training Activity
Day 1 (09:00 – 12:00)	Tyndall Orientation, Course Introduction & Packaging Tutorials (lectures)
Day 1 (14:00 – 17:00)	Laser Welding of Optical Fiber to InP Laser in 14-Pin Butterfly Package (hands-on)
Day 2 (09:00 – 12:00)	Electronic Packaging Technologies (hands-on)
Day 2 (14:00 – 17:00)	Fiber Array Packaging to Photonic Integrated Circuit (hands-on)
Day 3 (09:00 – 12:00)	Micro Optics Packaging (hands-on)
Day 3 (14:00 – 17:00)	Reliability & Failure Analysis of Photonic Devices (hands-on)

Course Details (Day 1)

09:00

17:00

Day 1a. Tyndall Orientation, PhotonHub Training, Course Introduction & Packaging Tutorials (lectures)

Location: Tyndall Conference Room

Details: Lectures on advanced packaging processes, packaging design rules with worked examples

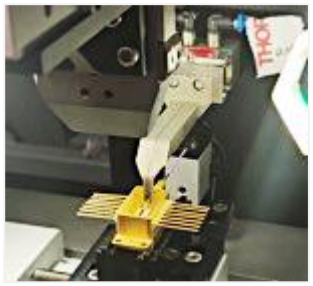
Training Duration: 3 Hours

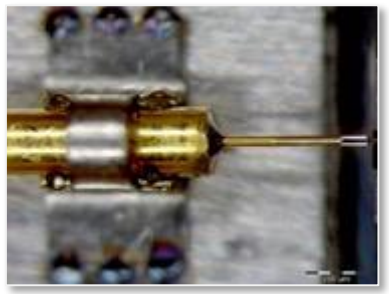
Day 1b. Laser Welding of Optical Fiber to InP Laser in 14-Pin Butterfly Package (hands-on)

Equipment Used: Nanosystec Nanoweld

Details: InP laser diode in 14-pin butterfly package and lensed Single Mode optical fiber

Training Duration: 3 Hours





Course Details (Day 2)

09:00

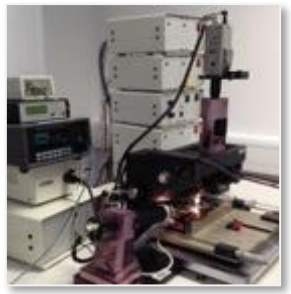
17:00

Day 2a. Electronic Packaging Technologies (hands-on)

Equipment Used: Finetech & ficonTEC Flipchip Systems, Pactech Solder Jetting System, Ball & Ribbon Wirebonder

Details: Flipchip silicon test structures on electronic substrate, solder jetting of micro solder spheres and electrical wirebonding

Training Duration: 3 Hours

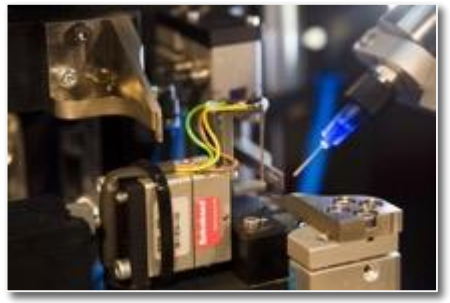


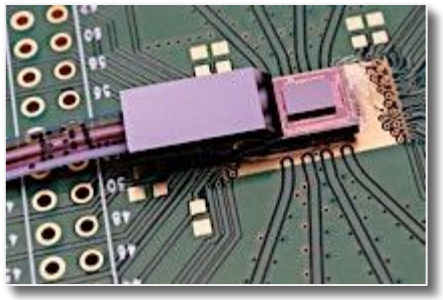
Day 2b. Fiber Array Packaging to Photonic Integrated Circuit (hands-on)

Equipment Used: Newport Autoaligner

Details: InP laser diode in 14-pin butterfly package and lensed SM optical fiber

Duration: 3 Hours





Course Details (Day 3)

09:00

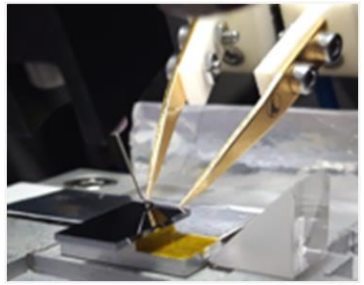
17:00

Day 3a. Micro Optics Packaging (hands-on)

Equipment Used & Location: Finetech & fiocnTEC Flipchip Systems, Pactech Solder Jetting System, Ball & Ribbon Wirebonder

Details: Flipchip silicon test structures on electronic substrates, solder jetting of micro solder spheres and electrical wirebonding

Training Duration: 3 Hours

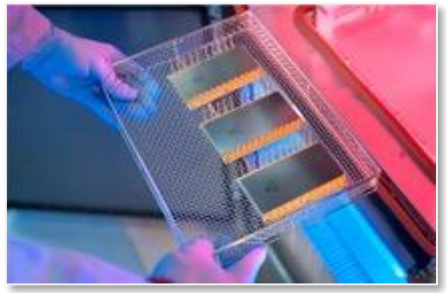


Day 3b. Reliability & Failure Analysis of Photonic Devices (lecture & hands-on)

Equipment Used: X-Ray & Acoustic Microscope Imaging, Die Shear Testing, Environmental Testing (e.g. humidity, thermal shock, vibration)

Details: Lecture on reliability and failure modes of photonic devices, with laboratory demonstrations of reliability analysis

Training Duration: 3 Hours



Course Trainers

Course Director: Prof. Peter O'Brien
Course Manager: Guillaume Le Palud

Packaging Tutorials: Dr. Padraic Morrissey
Optical Packaging: Dr. Kamil Gradkowski & Dr. Jun Lee
Electrical Packaging: Dr. Jun Su Lee, Marc Rensing, Noreen Nudds
Packaging Reliability: Marc Rensing

Course Material (technical hand-outs)

PHOTONHUB EUROPE

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Training Course Notes

Laser Welding of Optical Fiber to InP Laser in 14-Pin Butterfly Package

Equipment Used: Nanosystec Nanoweld

Materials Used: InP laser diode in 14-pin butterfly package and lensed single mode optical fiber

Training Duration: 3 Hours

The single-mode lensed fiber is edge-coupled to a 1550nm Fabry-Pérot (FP) laser diode (LD) chip in a metallic 14-pin package, see Figure 1. Notably, the lens of the fiber is shaped to provide a focused spot, typically a few tens of microns from the tip. The most common lensed fiber used has a spot size of 3-4μm which is compatible with a wide range of photonic waveguides, including silicon photonic mode adaptors and edge coupled laser diodes. The process of attaching the optical lensed fiber to a LD chip is commonly referred to as "fiber pigtailing". This is a critical step in the manufacturing process of LD modules and it is accomplished through precise optical alignment and laser welding. In particular, the welding process produces a robust attachment fixture, and is commonly used for high-end photonic devices used in extremely harsh environments (e.g. space or submarine applications).

Figure 1: *Laser welded lensed fiber in a 14-pin butterfly package.*

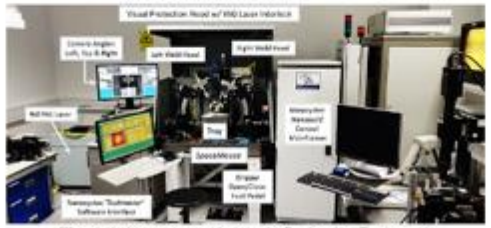

Figure 2: *Nanosystec Nanoweld Packaging Equipment.*

COURSE NOTES - PHOTONICS PACKAGING & INTEGRATION TECHNOLOGIES

Course Location, Schedule & Cost

- Course Schedule (20-22 June 2022)
- Number of people (Groups of 3/6/9 people per course)
- Course Cost (500 Euros per person, includes catering and project consumables)

Further Information

- Guillaume.lepalud@tyndall.ie
- www.tyndall.ie/contact-us
- www.photonhub.eu/euphotonicsacademy

Keywords

Technologies:

Packaging, Assembly, Optical Fiber, Micro Optics, Laser, PICs, Integrated Photonics,

Thermal, Electrical, Testing, Reliability, Failure Analysis, Design Rules

Manufacturing, Pilot Line, Ecosystem, Equipment, Automation

Applications:

Communications, Biomedical, Sensors, Agri-Food…