Microelectronic & Optoelectronic Package Assembly Capabilities
• **Company History**
  - Markets and Services

• Design & Assembly Capabilities

• Case Study: Compound Semiconductor Photonic module design & manufacture
Company History

2003 – Optocap Established

- Packaging services
- Customers
  - Start-ups & Spin-outs
  - Universities
  - Small and Medium Enterprises
  - Multinationals & Space Agencies

2016 – Acquisition by Alter Technology TUV Nord SAU

- IC Test services
  - Packaged devices
  - Wafer level
Group Presence & Customers

(markets & services)

Labs, Offices and reps.
Customers
• Company History
  - Markets and Services

• Design & Assembly Capabilities

• Case Study: Compound Semiconductor Photonic module design & manufacture
Design Capability

Optoelectronic & Optical Packaging

Hi-Reliability Packaging

Design for Manufacture

Optical Modelling
Package Design

Thermal Modelling
Mechanical Stress Modelling

New Product Introduction

Microelectronic & MEMS Packaging
Assembly Capability

- Automated Pick & Place
- Optical Alignment
- European Production
- Wafer Post Processing
- Hermetic Sealing
- Wire Bond
- Ceramic & Plastic Package
- Flip Chip
Assembly – Wafer Saw and Die Attach

**Wafer Dicing**
- Up to 8” substrates
- Si, GaAs, GaN, FR4, Glass, Laminates, Ceramics
- Multi-Project Wafers (MPW)
- Singulation of wafers from 100 microns to a few mm’s
- Optimised processes for MEMS and Sensor devices

**Die Attach**
- Pick from Gel, Waffle and Wafer (Die sizes from few 100’s μm to few 10’s of mm)
- Work to MIL-STD-883 as default
- Fully automated die attach processes
- Placement accuracy from +/-1 μm to +/-12.5 μm

- Range of Solder attach processes
  - Soft and Hard Solders (SAC, SnPb, In, AuSn, AuSi)
  - Flux and Fluxless processes
  - Screen print, solder dispense and solder preforms

- Wide range of Conductive and Non-Conductive Epoxies
  - Epoxy dispense and Epoxy stamping process
  - Thermal and UV cured epoxies
Assembly – Wire Bonding

- **Au Ball Bonding**
  - 17um to 33um Au wire diameter
  - Wire bond down to 50um pitch
  - Demonstrated 25um interleaved across 512 channel array
  - Die to Die Bonding
  - Reverse bonding
  - Double sided Bonding
  - Deep access wire bonding to 8mm
  - Fully automated - 8 wire bonds per sec

- **Wedge Bonding**
  - Au or Al wire

- **Ribbon Bonding**
  - 75um x25um Au ribbon
Assembly – Wire Bonding

UHV MEMS Package Application
- ion-trap array, Quantum Field Experimentation
Assembly – Bumping and Flip Chip

• Flip Chip and Au stud bumping

• In-House Au Stud bumping capability
  • Bumping can be performed on bare die or wafer scale level
  • Pitch down to 70μm
  • Bump diameters from 50 μm to 90 μm
  • Planarity +/-2 μm
  • Wide variety of bump shapes achievable

• Flip chip attach
  • Automated and manual processes
  • Thermocompression, Thermosonic and Reflow attach processes

• Typical Materials (other options available on request)
  • Substrate: BT Laminate, Ceramic, FR4, silicon
  • Packages: Customer specified
  • Underfill: Hysol FP4530, FP4511 etc.
  • Bump material: Au stud bumps, Eutectic, High Pb, Pb free
  • Die: Si, GaAs, GaN, SiGe, MEM’s, InP, GaN
Assembly – Encapsulation and Sealing

- Glob top and dam and fill
  - Automated epoxy dispense systems
  - Chip on Board Applications

- Seam seal, Solder seal and Projection Weld
  - Ultra low moisture environments <1000ppm
  - Specialist sealing environments He, N, Ar, O₂
  - Fine and Gross leak test to MIL-STD-883, (Space Flight Module Applications)
Assembly – Optical Alignment and Attach

- Lensed SM and PM fibre align and attach using laser weld attach process
- Epoxy attach for multi-mode fibers and Fibre V-groove arrays
- Align and attach capability for free-space optical components such as FAC, SAC, Isolators and Focusing lenses.
- Auto align 3 and 6-axis sub-micron alignment stages
- Test capabilities
  - Optical beam profilers, PER meters, Optical spectrum analysers, LIV Testing
- Applications
  - FAC and SAC lens align and attach to red laser diode in custom TO-header
  - PM Fibre coupled DFB laser with collimating and focusing lenses and optical isolator
  - Integrated miniature optical systems
  - V-groove attach (vertical & horizontal): GC on PIC
Assembly – Optical Alignment and Attach

- Example of integrated sub-system (PD-PIC-ROIC) assembly development
- Technology development study to meet environmental and application requirements
Embedded solution:

- Integrated SLED sub-module
- Improved optical coupling via horizontal fibre v-groove to grating coupler attach
• Company History
  - Markets and Services

• Design & Assembly Capabilities

• **Case Study: Compound Semiconductor Photonic module design & manufacture**
Case Study:
Integrated Compound Semiconductor Photonic module

Integrated RGB laser light module for autostereoscopic outdoor displays
Integrated CS Photonic sub system Case Study

Integrated RGB laser light module for autostereoscopic outdoor displays

- Integrated Optical & microelectronic sub assembly
- Custom design solution for pilot manufacture / proof of principle
- Hermetic Package / controlled internal environment
- Mechanical design:
  - Outer package & sub assembly
  - Process tooling and fixtures
- Optical & Thermal Design & Simulation study
- Process Development:
  - LD placement
  - FAC/SAC Active Alignment

World’s smallest RGB Laser Light Source  (SPIE LASE 2015, San Francisco, CA,USA)
3D CAD model: Mechanical design: optical, thermal simulation
Case Study

Tolerances, Process / tool design

Figure 4. (a) Top and (b) front view of the laser diode subassemblies.

Figure 5. Assembly including FAC lens.

Figure 6. Hermetically sealed package.

LD flip-chip attach 3μm accuracy
Active Alignment of lens Probes → Probe card

Optical Output
Integrated RGB laser light module for autostereoscopic outdoor displays

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Abstract

We have developed highly compact RGB laser light modules to be used as light sources in multi-view autostereoscopic outdoor displays and projection devices. Each light module consists of an Altair® red laser diode, a Quant blue laser diode, a Statik green laser diode, as well as a common cylindrical microlens. The plano-convex microlens is a so-called “fast auto collimator”. The three light beams emitted from the red, green, and blue laser diodes are collimated in only one transverse direction, the so-called “fast axis”, and in the orthogonal direction, the so-called “slow axis”. The beams pass the microlens uncollimated. In the far field of the integrated RGB light module, the produced Gaussian beams have a large ellipticity. For this application only very low optical output powers of a few milliwatts per laser diode are required and therefore we have developed tailored low power laser diode chips with short cavity lengths of 750 μm for red and 300 μm for blue. Our RGB laser light module including the three laser diode chips, associated monitor photodiodes, the common microlens, as well as the hermetically sealed package has a total volume of only 0.45 cm³, which to our knowledge is the smallest RGB laser light source to date.

Applications

- RGB laser module components
- Optical properties
- System parameters
- Assembly and packaging
- References
- Acknowledgments

Figure 1. Glass-free 3D outdoor display for digital signage applications.

Figure 2. (a) Ridge waveguide cross section and (b) top view of the red laser diode.

Figure 3. UV curves of the (a) red and (b) blue laser diode.

Figure 4. (a) top and (b) front view of the laser diode subassemblies.

Figure 5. Assembly including I/O lenses.

Figure 6. Hermetically sealed package.

Figure 7. Far field fast axis beam patterns at a propagation distance of 50 cm.

Figure 8. Far field slow axis beam patterns at a propagation distance of 50 cm.

References


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