CENTRE NATIONAL D'ÉTUDES SPATIALES

Round table
Laser diodes : main issues to be solved

Part	Cause	Main enhancement factor	Solution (?)
Active region	Dislocation, precipitation	Current, temperature	Screening tests : - wafer level (?) - component level (I-V, P-I, spectrum…)
Chip	Sawing, cleaving defect (cracks)	Temperature	Screening through visual inspection
Facet	Oxidation	Light, moisture	- Reliable facet passivation technology (=>COD threshold measurement), - Low humidity content inside the package (diodes should be used above dew point => how could we obtain a reliable estimation of the dew point temperature?)
Facet	Nodular defects in the passivation layers, partial delamination	Temperature	Screening through visual inspection
Electrode	Metal diffusion, alloy reaction	Current, temperature	Insure reliable electrode-semiconductor interface (choice of electrode metals)
Bonding parts	Solder instability (migration, voids, intermetalic generation, whisker growth, thermal fatigue …)	Current, temperature	Select reliable soldering alloys depending on the stress acceptable at the chip level (AuSn vs. SnPb vs In vs …)
Package	Package induced failure (organic compounds cracking onto the facets leading to COD)	Optical power density at the mirrors	- Avoid organic compounds in the package (epoxies and aromatic in particular) - About 10% of oxygen should be used inside the cavity to oxidize residues of organic materials. - Getters could be placed inside the package to trap water (oxidation by-product of organic compounds)

FUTURE R&D ACTIVITIES

- Reliability assessment and characterisation of 852nm (and other wavelenghts e.g. 1550nm) DFB diodes CNES J Berthon
- Assessment of narrow-band active Opto-electronic structures based on photonic crystal lasers ESA E Murphy
- Laser linewidth\bandwidth intercomparison facility ESA E Murphy
- Ion doped planar waveguide lasers development ESA E Murphy
- Radiation assesment of opto-electronic modules including VCSEL, drivers, PIN diodes inside the module ALCATEL-ALENIA – SPACE N Venet
- Module multiple fibre connector qualification AAS N Venet
- Frequency reference distribution : reliable 1.55 microns DFB and 980 nm pump for EDFA (european sources) AAS M. Maignan
- Free space amplifier : 980 nm pump for EDFA and 1.55 microns DFB (european sources) + Er doped fibers B. Roy EADS Astrium
- Power sources at 808 nm (reliability assesment) B. Roy EADS Astrium

STRATEGIC COMPONENTS AND WAVELENGTH

- **Wavelengths :**
  - 1550 (telecom, clock distribution), 980 (pumping, telecom, clock distribution), 852 (telecom, atomic clocks), 800(beacon), 1064(YAG), 808(telecom, pumping), 780 (Rubidium clocks), 1560 (telecom, clocks)…

- **COMPONENTS:**
  - VCSEL (850nm) , Minidil package (980nm; because of terrestrial operation similarity), Detectors within the diodes (1550-850nm), Cooling systems, surface mount package, multichannel connectors, connectors, photonics crystals, EDFA amplifiers, radiation hard fibres (MM & SM), high power laser diodes

- **STRATEGY:**
  - Start with (technology + functional +reliability) EVALUATION then in C\D phase proceed to qualification,
  - Pre qualification for COTs before the program is decided (phase A and B)
  - Think of industrial medium: help START UPs in Europe (evaluation efforts?)
  - Start ups feel a bit out of the loop where space requirements are concerned: FIND solutions! Expose to ROADMAPS?
  - Divide roadmaps into high quantity (telecom) applications and low quantity (scientific) applications

CHARACTERISATION

- Qualifiation procedures and characterisation methods should be outlined,
- Where can we characterise\qualify our components?
- Failure analysis: where and which methods?
- Tests of hermeticity how to perform it and does it change our qualification?
- Database with history of failure analysis!
- Database for qualified (including radiations) products (COTs especially)
- COTs and procedure changes (lot)
- How to compute MTTF : guidelines needed
- Same for upscreening