Some Analyses of VCSEL Problem

- Reliability statistics on AOC and ULM VCSEL arrays
- Analysis of 9 channels on opto-boards with no light

K.K. Gan
The Ohio State University

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ULM Reliability Data

- produced ~50 wafers of 10 G and ~20 wafers of 5 G
- a sample of 15 channels from each wafer was tested with 85% RH/85°C at 6 mA
- two 10 G wafers failed
  - failure with 5 G is slightly higher though not significantly
- 10 G process has not been changed for two years
- 5 G process was updated two years ago
  - the change was not related to humidity resistance

Info courtesy of Michal Z.

AOC Reliability Data

- sort the dice from a wafer into 5 and 10 G arrays
  - ⇨ there is only one fabrication process
- produced 52 wafers
  - ⇨ total of 860 arrays tested at 85% RH/85°C for 1000 hours
  - ⇨ 16.5 arrays or 198 channels per wafer
  - ⇨ none failed
- last change in process is 2005-6:
  - ◆ moving from Honeywell plant to Finisar (16 km apart)

AOC vs. ULM Reliability Data

- both claim their VCSELs to be hermetically sealed
  - VCSELs pass the 85% RH/85°C test for 1000 hours
- AOC tested ~13 x more VCSELs/wafer
  - 2 failed in ~50 ULM wafers
  - none failed in 52 AOC wafers
  - ⇨ plan a side-by-side comparison of
    20 AOC vs 20 ULM arrays at 85% RH/85°C for extended time

Analysis of 9 VCSELs producing no light

- 9 VCSELs on 5 opto-boards (attached to modules) produce no light
  - Josh Moss et al. studied the thermal effect (shift in wavelength) on adjacent channels when attempting to pass current through the broken channels
    - shift in one channel
      - ⇨ dead VCSEL
        - new DORICs added on other side of opto-board
    - no shift in 8 channels
      - ⇨ VCSELs are not connected

Analysis of 8 Dark VCSELs

- Most likely a break in continuity
  due to cold solder on leads of opto-packs
- 1 OSU opto-board with one dark channel
- 2 Siegen opto-boards with one dark channel each
- 1 Siegen opto-board with two adjacent dark channels
- 1 Siegen opto-board with three adjacent dark channels

Re-soldering Statistics

- soldering was challenging during production
  - supply sufficient heat to 100 μm lead in contact with BeO
  - supply too much heat will cause lead detachment inside opto-pack
- many re-solderings during production
- statistics on opto-pack re-soldering during installation
  - 4 PIN channels
  - 10 VCSEL channels
    - ⇨ more re-soldering on VCSEL channels (more later)
  - 1 opto-pack of each type has 2 none adjacent channels re-soldered
    - ⇨ no re-soldering on adjacent channels

Test of Cold Solder Theory

- number of cold solder channels should be approximately the same for both type of installed opto-packs
- 2 cold solder channels in PIN opto-packs
- 8 cold solder channels in VCSEL opto-packs
- the different in rate is not understood
  but consistent with rework statistics!

Summary

- AOC arrays appear to be better in comparison with ULM based on info provided by the vendors
- 8 dark VCSEL channels are mostly likely due to cold solders