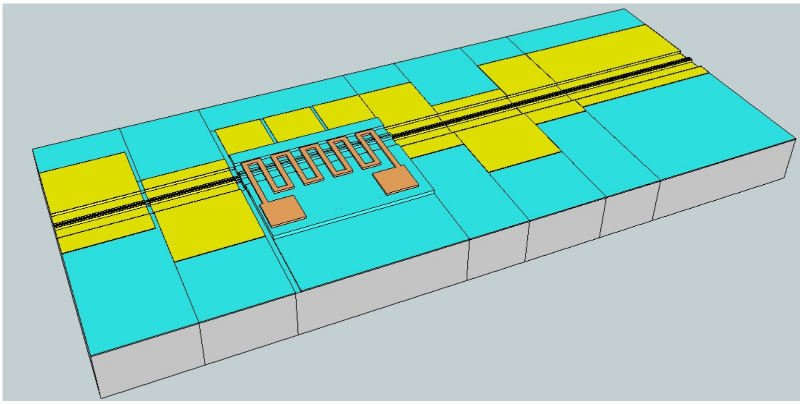
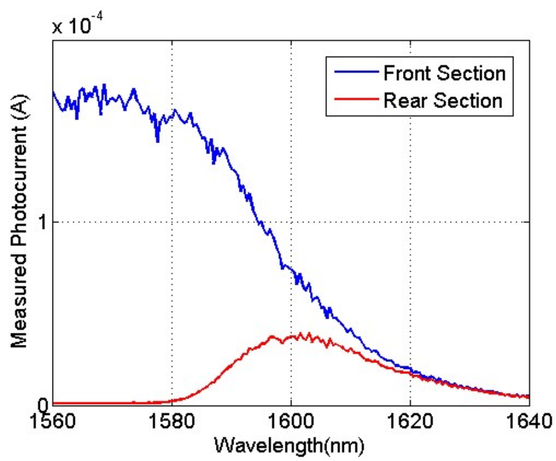
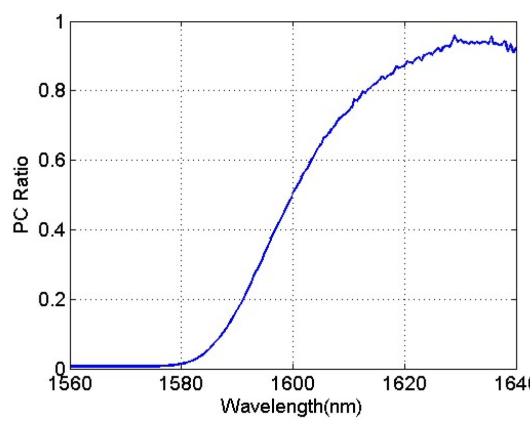
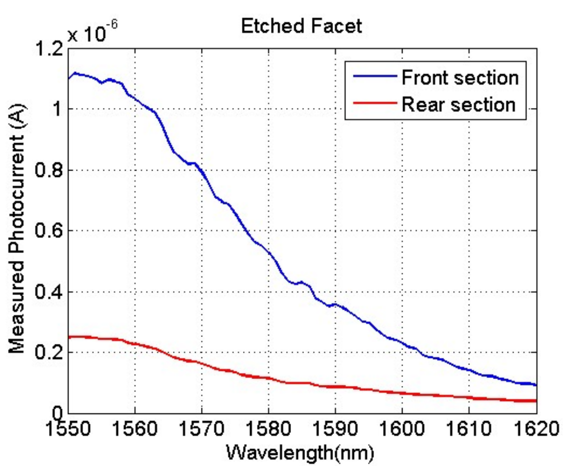
Chapter 4: Integration

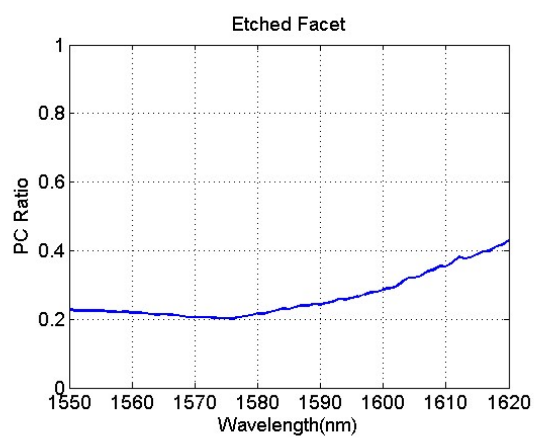


Starting vision was this above…







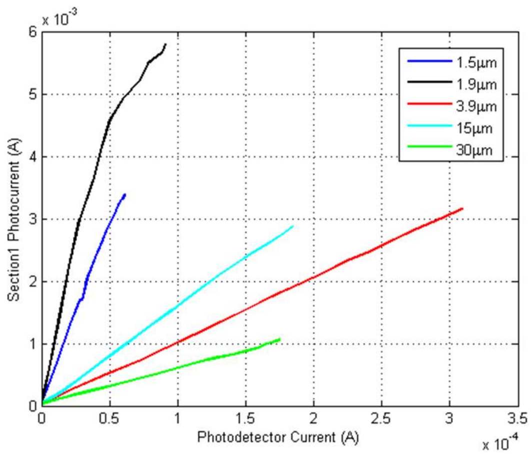


Change the below animated gif to a standard multiple plot. Fibre misalignment data. Misalignment in the X direction (away from the facet) seems to be stable for at least 30µm.

Misalignment in the Z direction (into the substrate) is very sensitive (<7µm)

Cleaved facet gives perfect results (in comparison with literature)

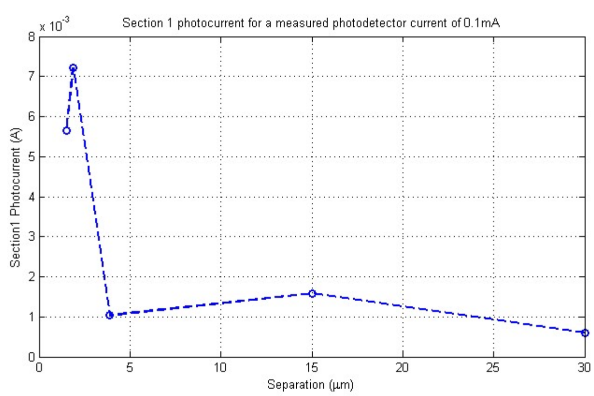
Etched facet results in poor performance. The rear section does not show the characteristic rise-and-fall curve.

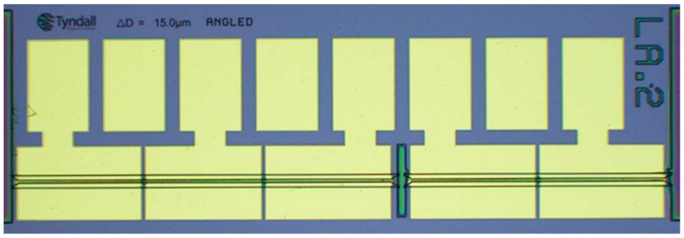


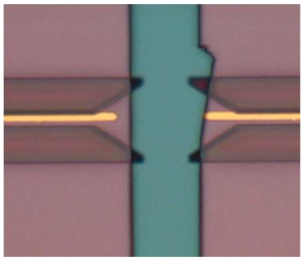
For the laser-wavelength monitor gap, we chose 15 um

good signal strength and linearity, while unlikely to produce feedback

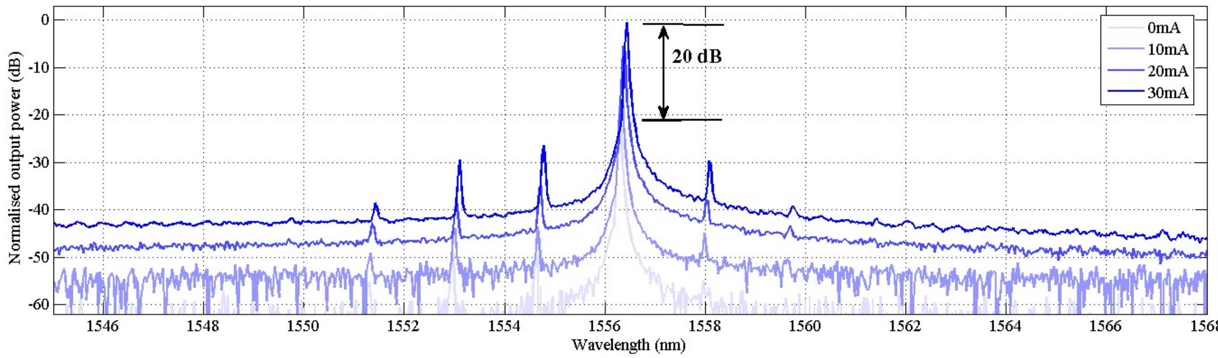
From the animated GIFs make a static plot for 3.9um and 15um devices. Showing that 15 is better. Run some sims as well, and maybe also 15um is better from there?

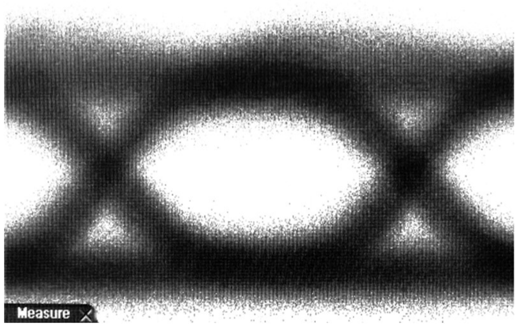


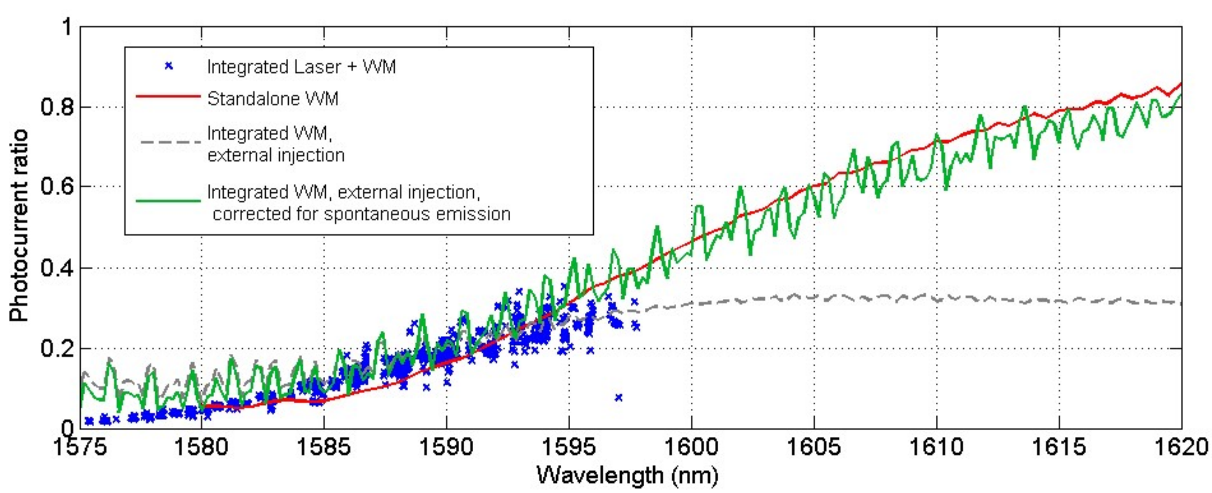

Tyndall
ΔD = 15.0μm ANGLED
LA.2



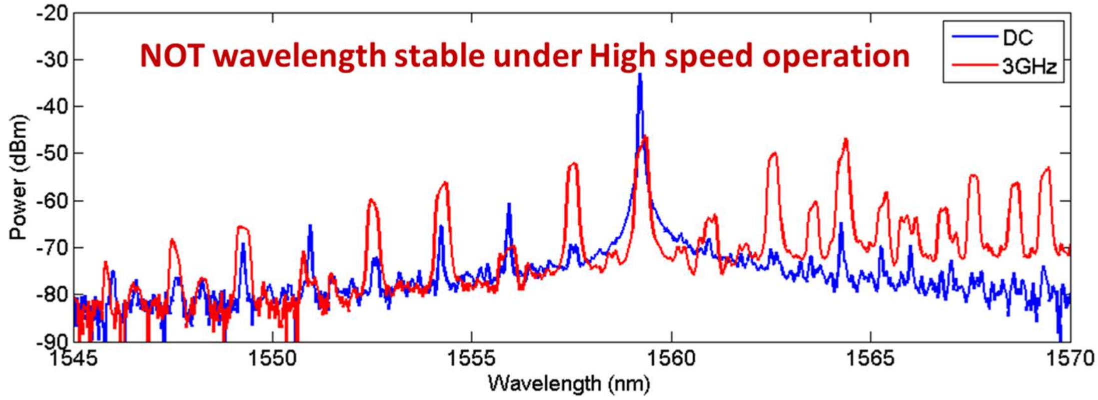
Integrated SOA





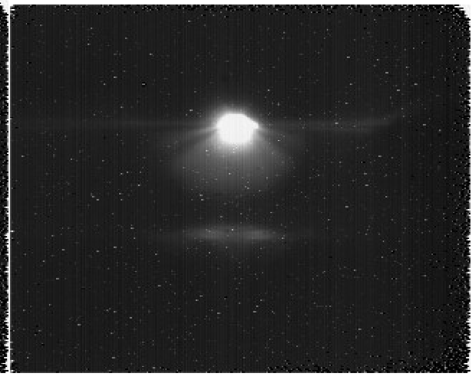


Under non-angled facet, Modulator is not wavelength stable.



NOT wavelength stable under High speed operation
DC
3GHz
Power (dBm)
Wavelength (nm)
-20
-30
-40
-50
-60
-70
-80
-90
1545
1550
1555
1560
1565
1570

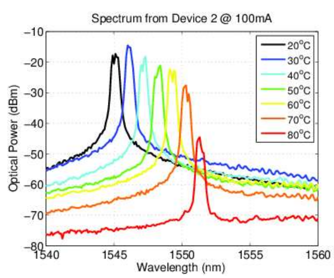
Chapter 5: Crosstalk evaluation

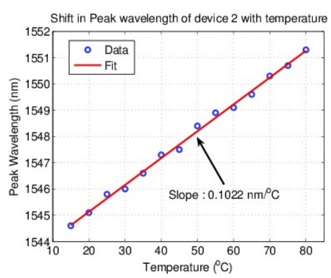



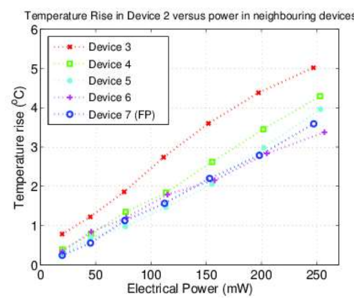
Left: A1779, Right IQE: with infrared camera. IQE shows substrate glow, whereas A1779 does not.

TODO: Subtract background image

Thermal crosstalk

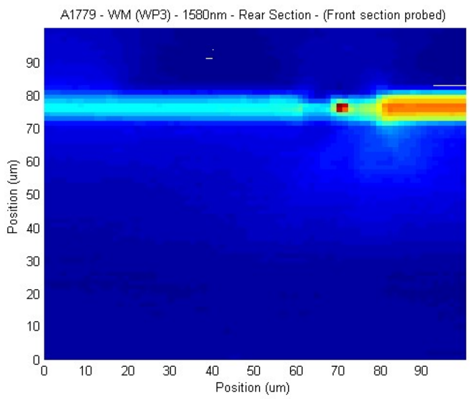


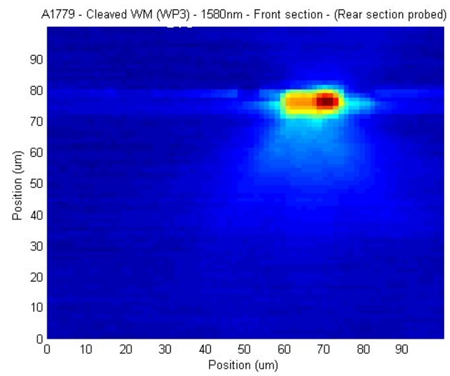




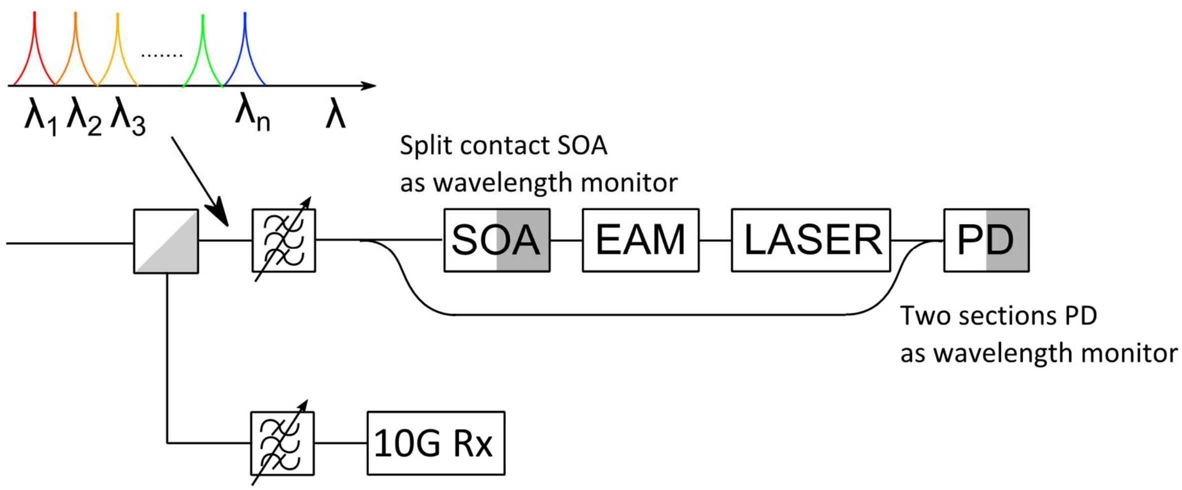
Plot distance between devices and plot that against shift in wavelgenth/temp

Optical Crosstalk





Chapter 6: System Performance



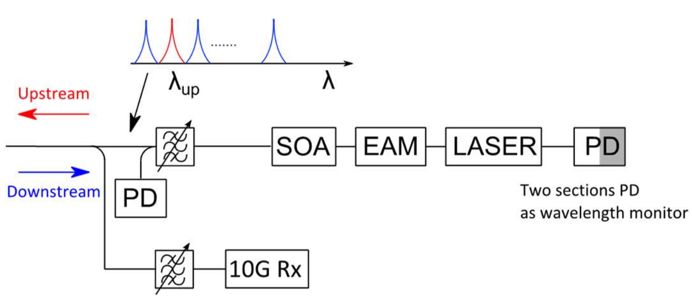
- Laser is first coarsely calibrated by consumer

  box disconnected from network, press ‘auto-calibrate’ after purchase

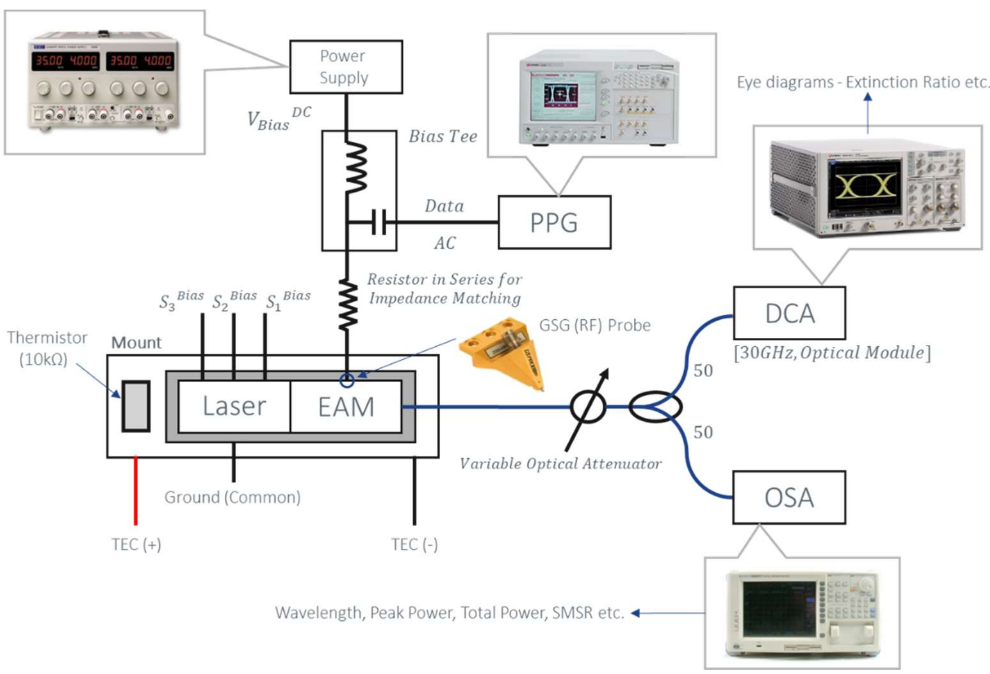
  15-20 seconds to generate internal look-up-table, in ‘internal units’ of wavelength (done)
- When in operation, the OLT/filter gives a reference wavelength

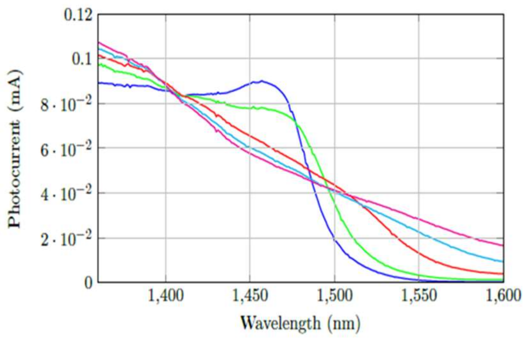
  this can provide an ‘absolute internal unit’
- Laser is tuned close to this ‘internal unit’ via look-up table
- Then fine tuned for the best match

Second design :

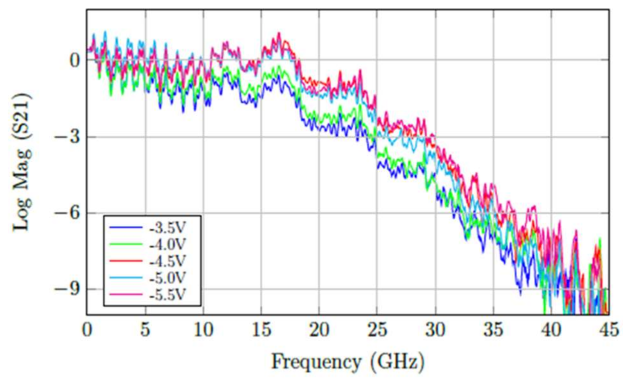


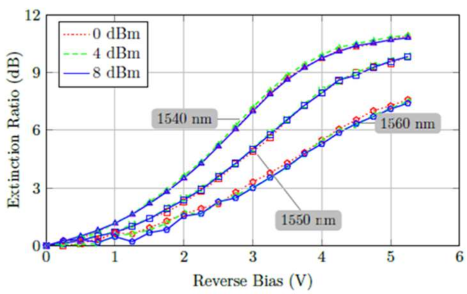
- US and DS channels are interleaved on a 50GHz grid
- US filter is tuned to a DS wavelength
  - i.e. SOA used as detector
- Two section wavelength monitor is calibrated using the DS wavelength
  - SOA and laser could be biased to provide gain below threshold
- This provides a calibration point for both wavelength monitor and tuneable filter
  - One or more calibration points can be interpolated
- Interpolated calibration points are used to tune filter and laser





Absorption spectra



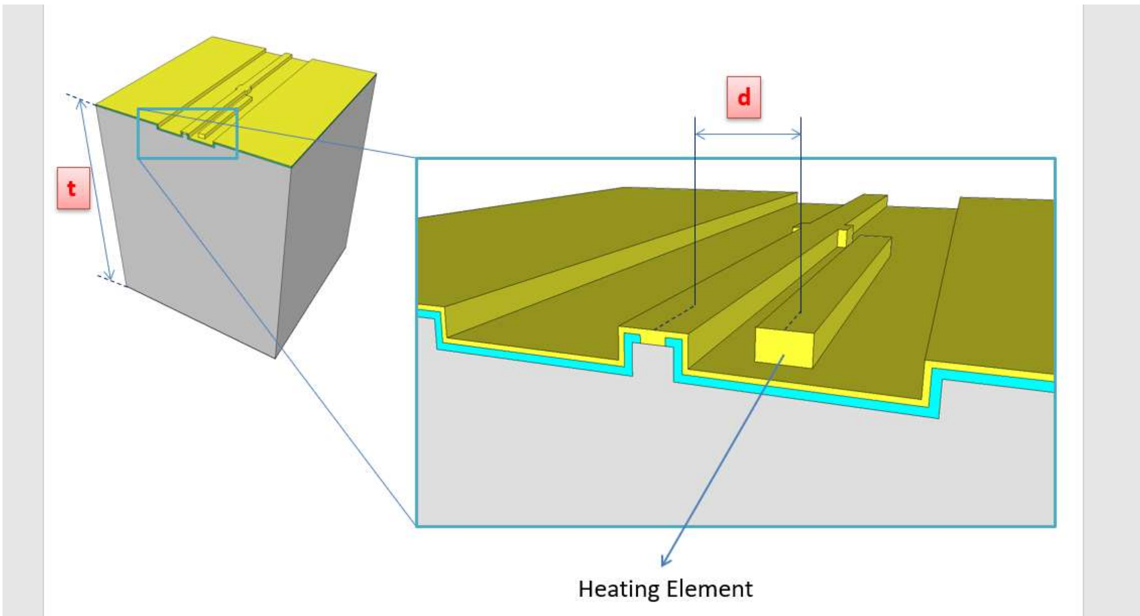


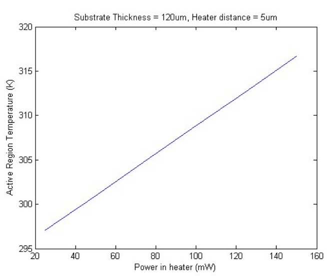
Extinction ratio

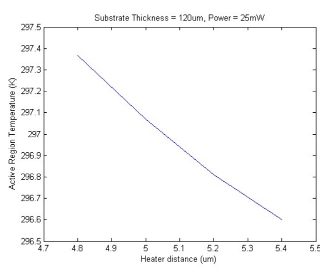
The above are from previous EAMs. Try to get these kinds of results from integrated EAM.

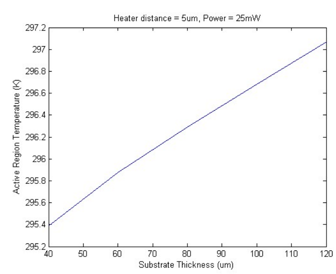
Chapter 7: Conclusions and Outlook

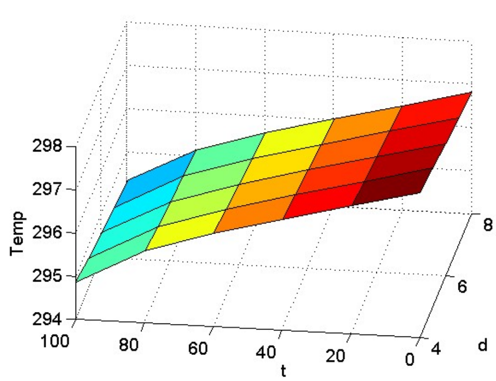
Local heating

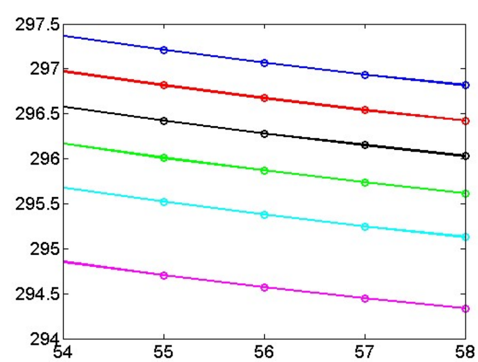


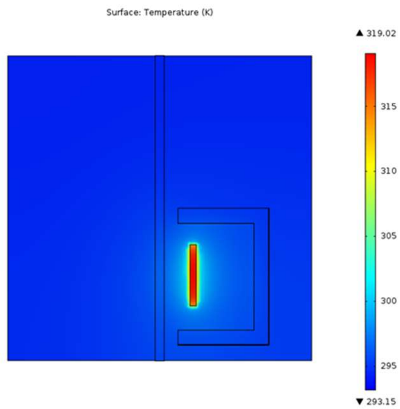


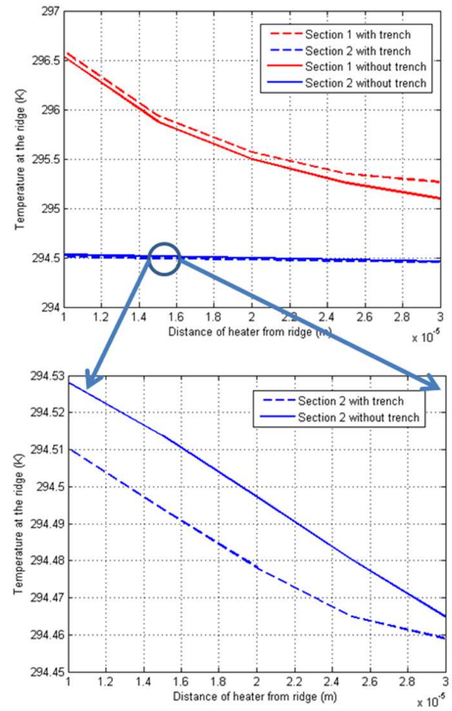


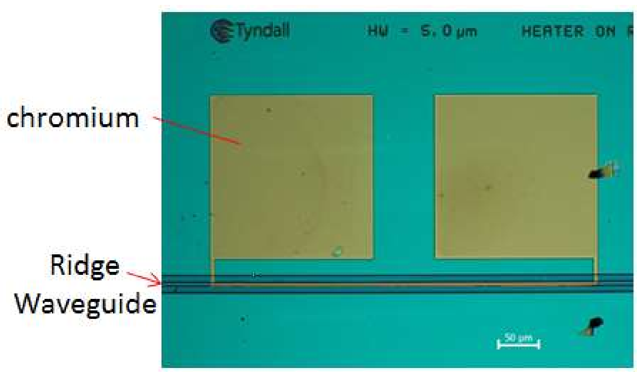


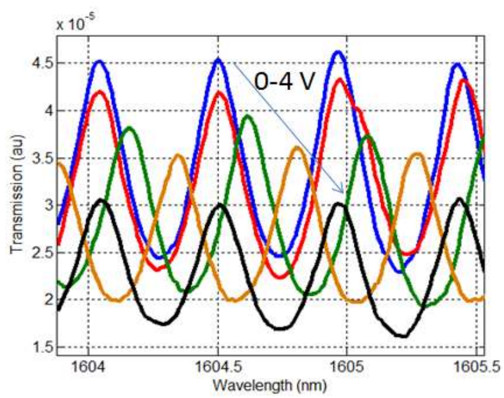








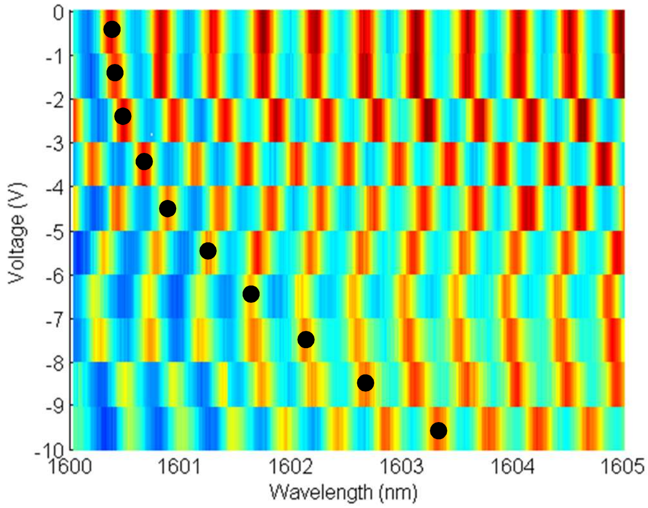




Chromium heaters adjacent to the ridge waveguide

Ridge temperature rise of about 6^{o}C

(heater power ~ 20mW)



Plotting data from 0 to 9 V (=0 to 10 mA) gives the above figure.

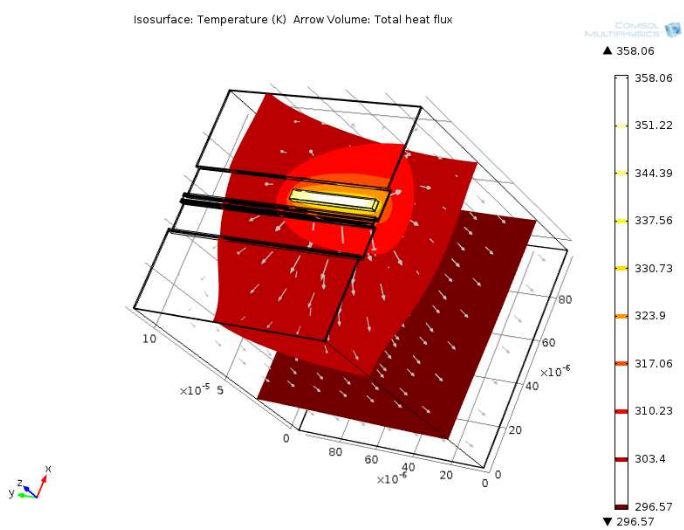
Same peak tracked with black dot

Single pass $V_{□}$ can be achieved by varying 0-4 V or 6-7 V in ridge length of 750 um

nonlinear due to Joule heating

Absolute refractive index change = $V^2/14400$

will be different for different configurations



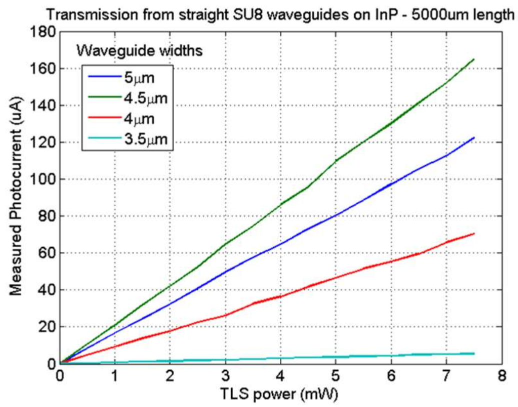
Thermal modelling in COMSOL Multiphysics :

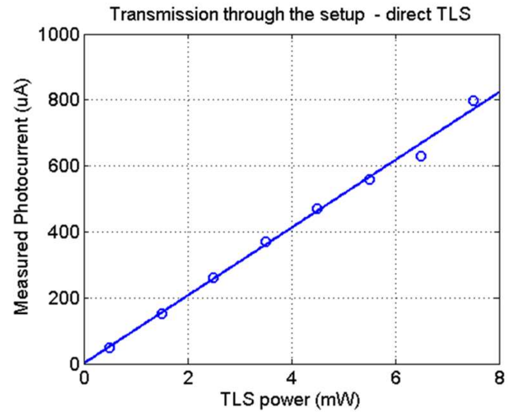
An ‘etched facet’ trench effectively isolates thermal crosstalk between devices

A localized heater on one section of the tuneable laser does not affect the adjacent section very much.

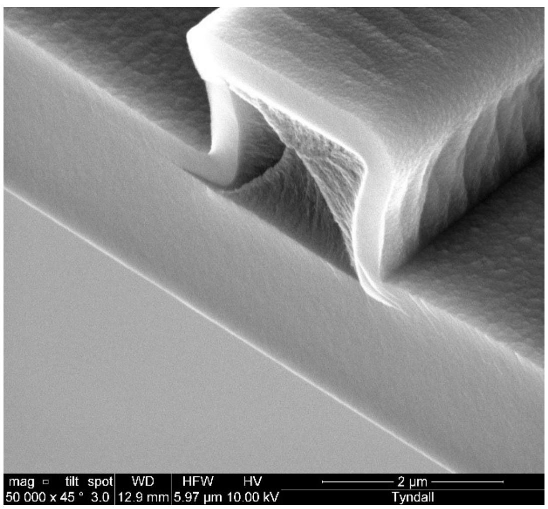
In reality, of course, the quality of the mounting and packaging needs to be evaluated.

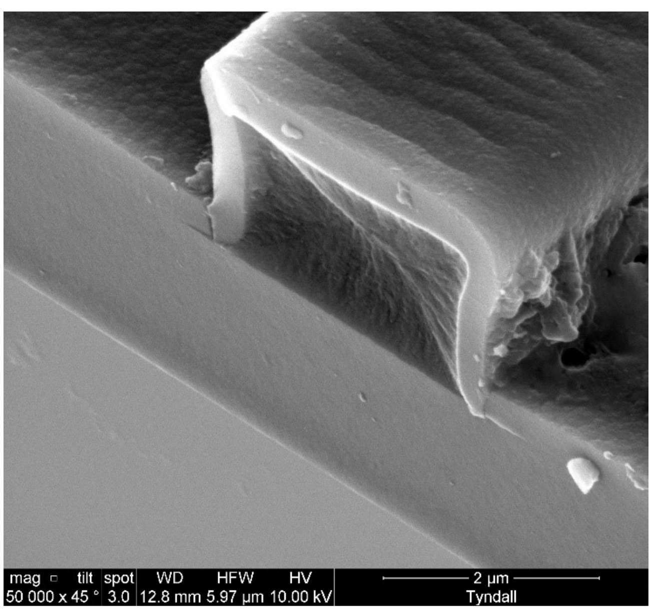
Can we do SU8 waveguides?

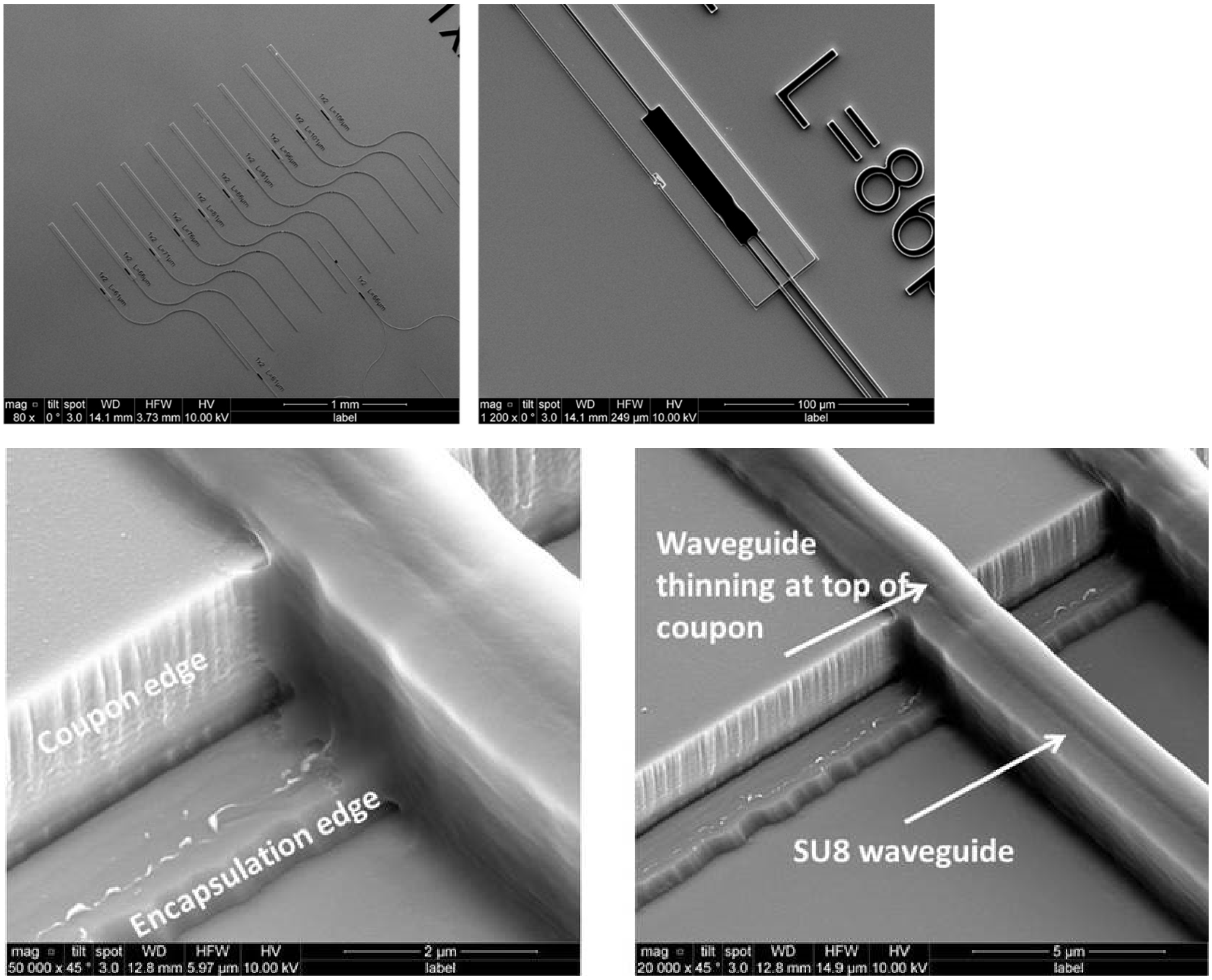




Can possibly extract loss from here.





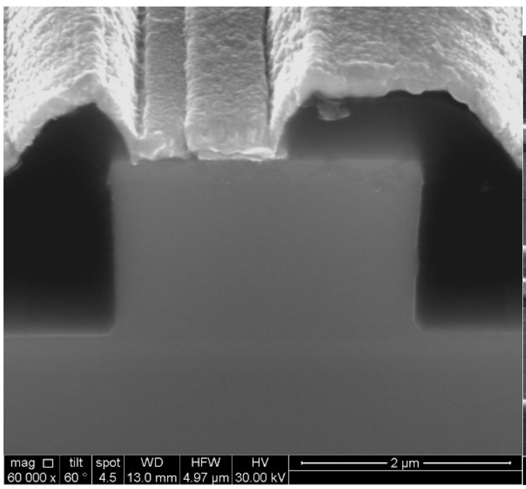

mag tilt spot WD HFW HV
80 x 0 ° 3.0 14.1 mm 3.73 mm 10.00 kV
1 mm
label
L=86
mag tilt spot WD HFW HV
1 200 x 0 ° 3.0 14.1 mm 249 µm 10.00 kV
100 µm
label
Coupon edge
Encapsulation edge
mag tilt spot WD HFW HV
50 000 x 45 ° 3.0 12.8 mm 5.97 µm 10.00 kV
2 µm
label
Waveguide thinning at top of coupon
SU8 waveguide
mag tilt spot WD HFW HV
20 000 x 45 ° 3.0 12.8 mm 14.9 µm 10.00 kV
5 µm
label

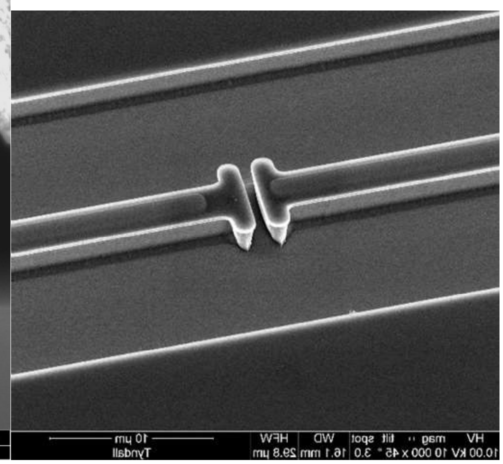
Appendix

Do we need PL measurement data ? There is for IQE wafers, but none for A1779

Appendix : Processing flow : Run sheet: and then images from

Processing_flow_EF
Lasers_2014.pptx





Layer	Material	Thickness (nm)	Doping level (cm^{-3})	Dopant	Comment
26	InGaAs	40	$>1x10^{19}$	Zn	
25	InGaAs	80	$\sim1x10^{19}$	Zn	
24	InP	1500	$\sim1x10^{18}$	Zn	
23	InGaAsP	6	$\sim5x10^{17}$	Zn	
22	InP	40	$\sim1x10^{17}$	Zn	
21	CIL (InGaAs)	(2-5)	-	-	Minimal thickness
20	$(Al_{.9}Ga_{.1})_{.47}In_{.53}As$	40	-	-	
19	$(Al_{.7}Ga_{.3})_{.47}In_{.53}As$	75	-	-	
8 x 6	$(Al_{.45}Ga_{.65})_{.51}In_{.49}As$	10	-	As A1734	Tensile strained barrier

					~-0.3%
7 x 6	$(Al_{.25}Ga_{.75})_{.3}In_{.7}As$	6	-	As A1734	Compressive strained quantum well ~1.1%
6	$(Al_{.45}Ga_{.65})_{.51}In_{.49}As$	10	-	-	Tensile strained barrier ~-0.3%
5	$(Al_{.7}Ga_{.3})_{.47}In_{.53}As$	75	-	-	
4	$(Al_{.9}Ga_{.1})_{.47}In_{.53}As$	40	$1x10^{18}$	Si	
3	InP	1500	$1x10^{18}$	Si	Lower cladding
2	InGaAs	1000	$\sim 1x10^{18}$	Si	Etch release layer
1	InP	100	$1x10^{18}$	Si	buffer
	InP substrate		-	N-type	3 wafers