

Optical Beam Steering

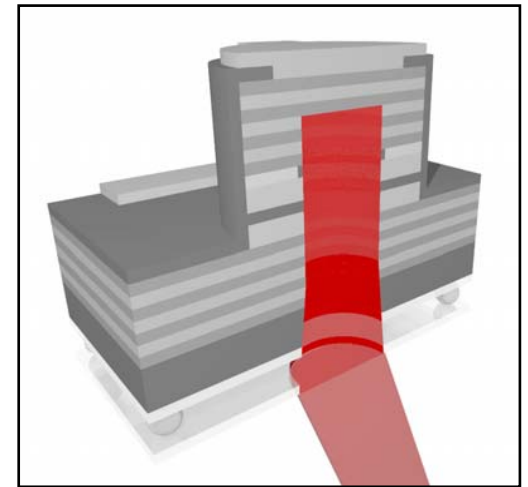
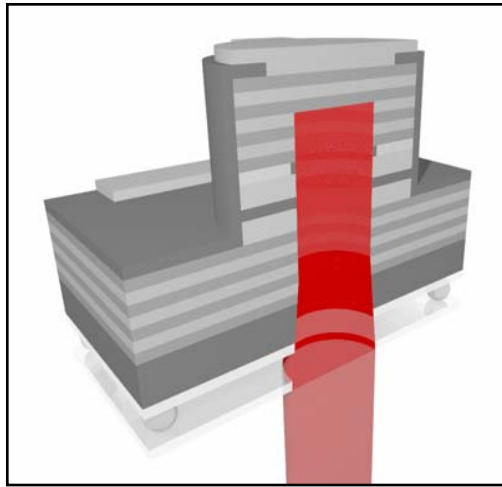
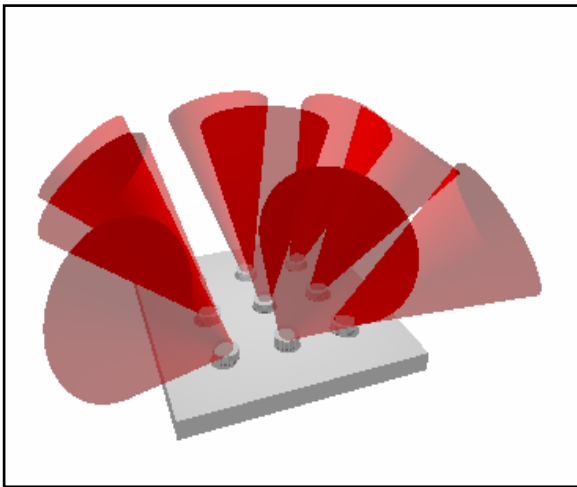
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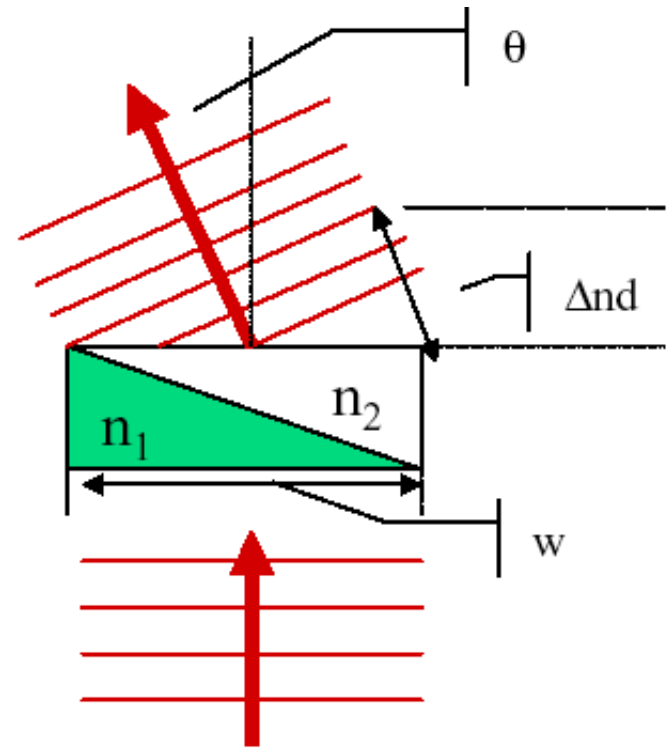
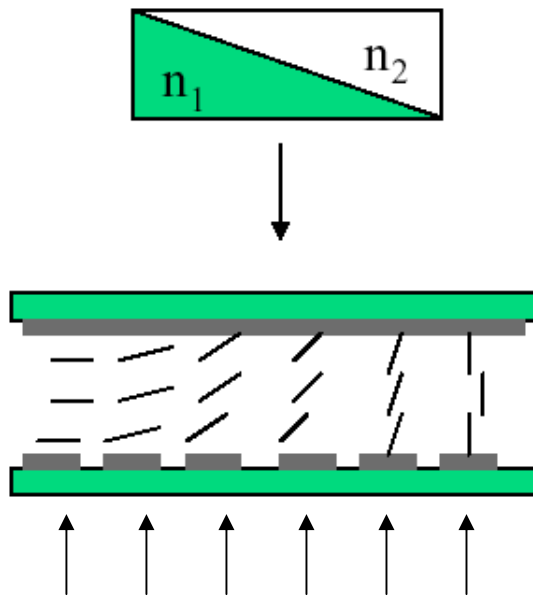
Different approaches

- To cover the same communication volume as Radio we require:
 - Multiple Lasers
 - “Steerable” Lasers



Liquid Crystal – VCSEL approach

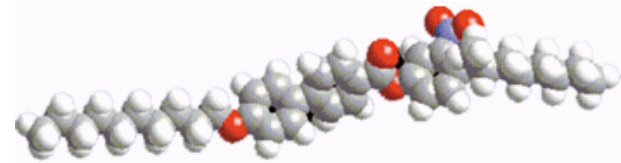
- Steering power : μW (few V)



$$\sin \theta = \Delta n d / w$$

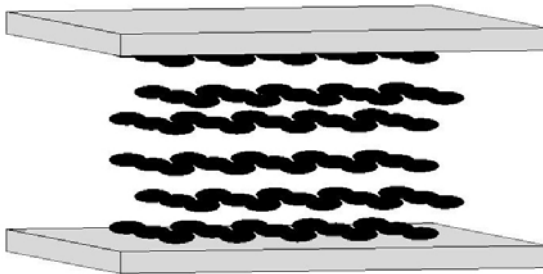
Liquid Crystals

- Liquid crystals are found to be birefringent, due to their anisotropic nature. Which is due to the alignment and the shape of the molecules.

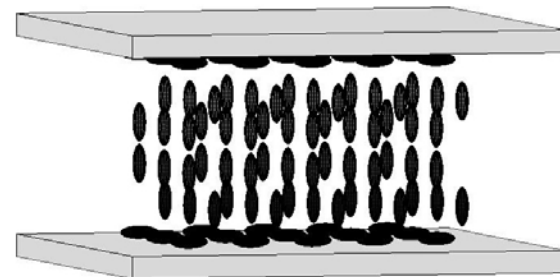


- Characteristics:
 - A rod-like molecular structure
 - Tendency of the molecules to point along a common axis
 - Strong dipole

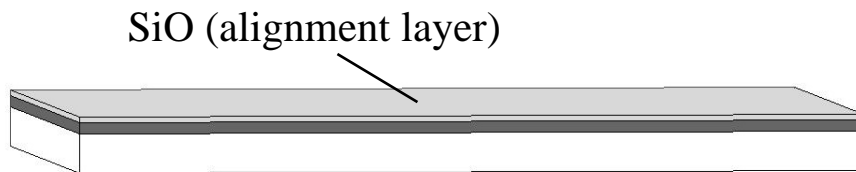
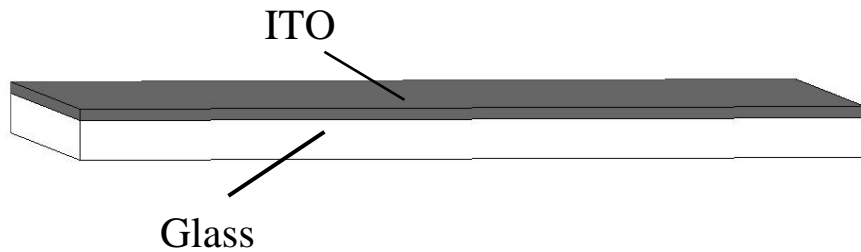
$E=0$



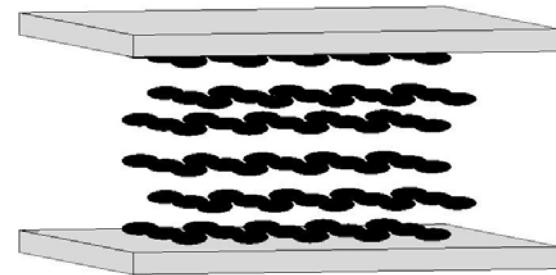
$E=\max$



Liquid Crystal Cell

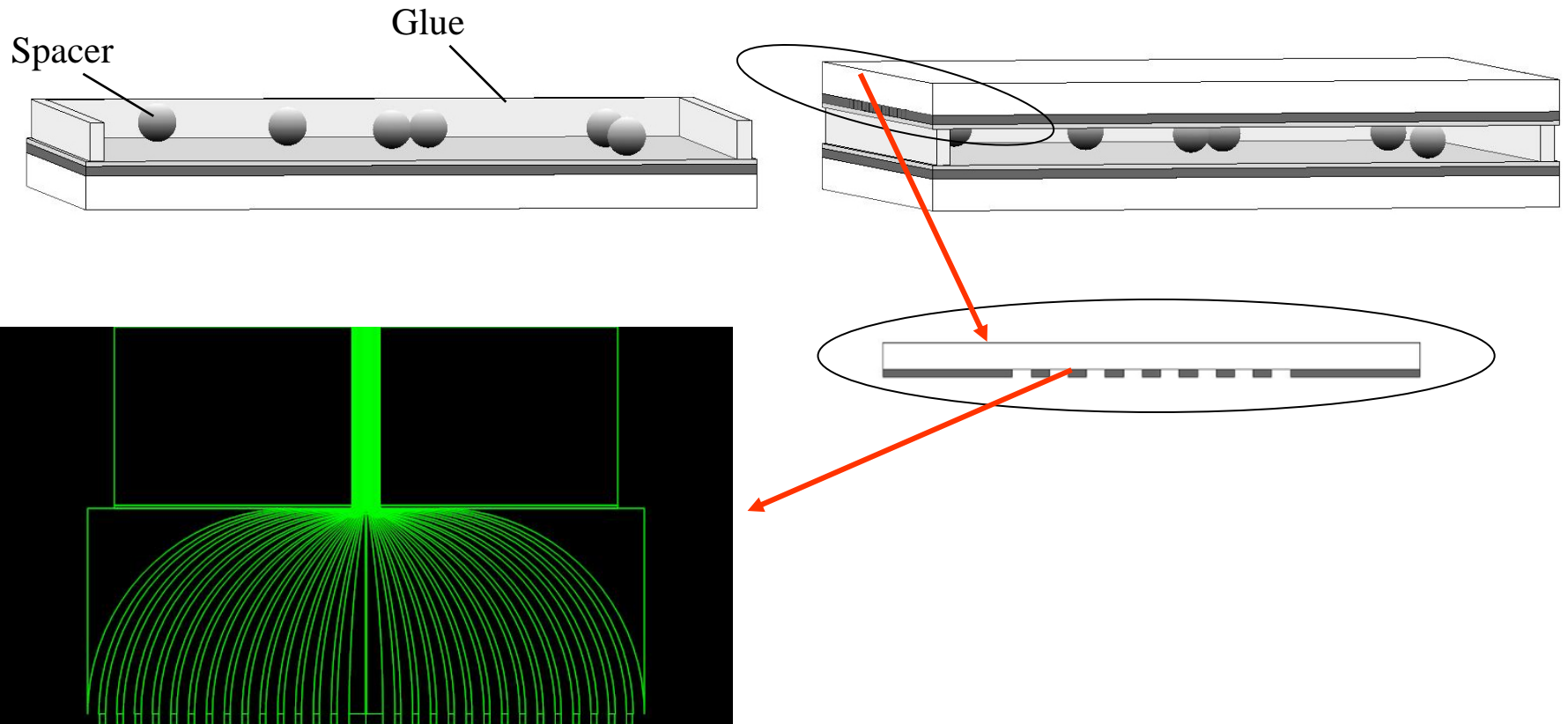


$$E = 0$$

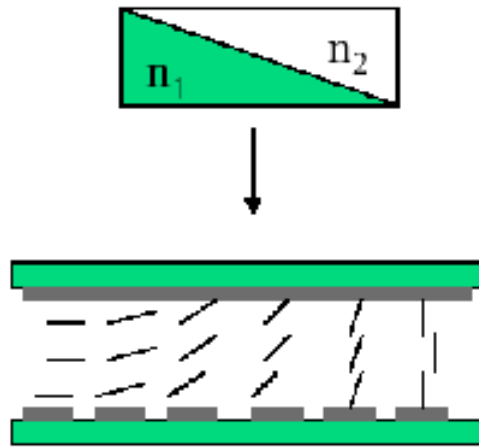


ITO = Indium Tin Oxide (transparent and conducting)

Liquid Crystal Cell

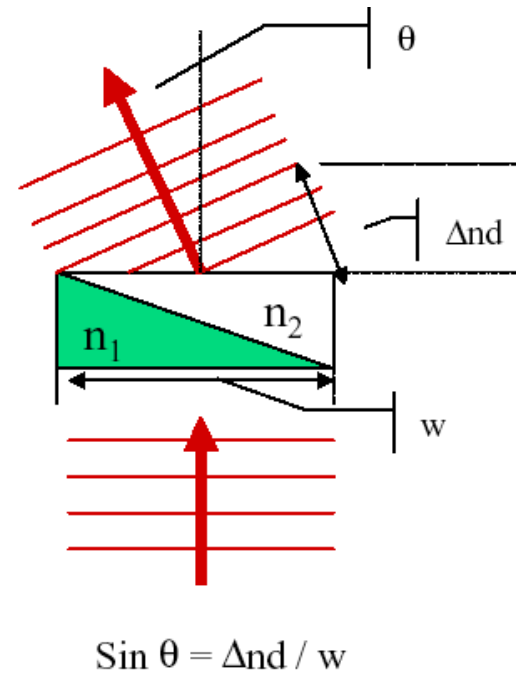


Liquid Crystals

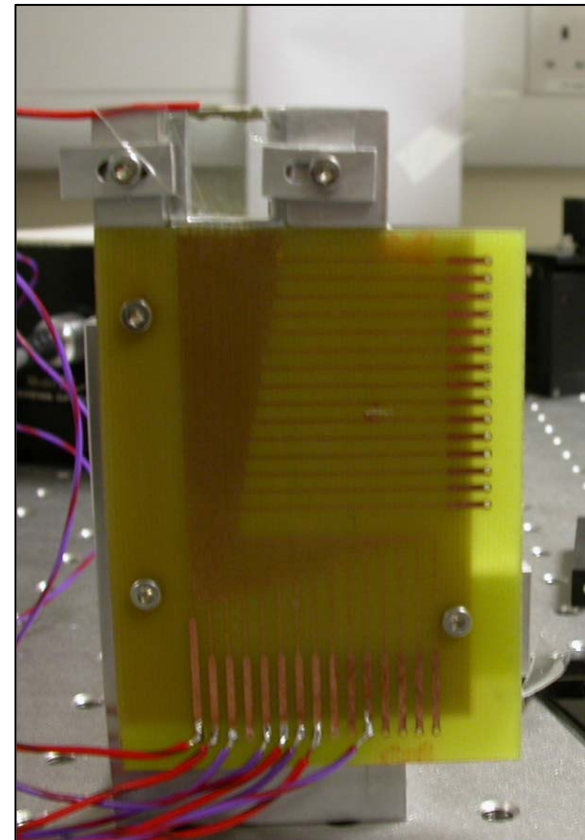
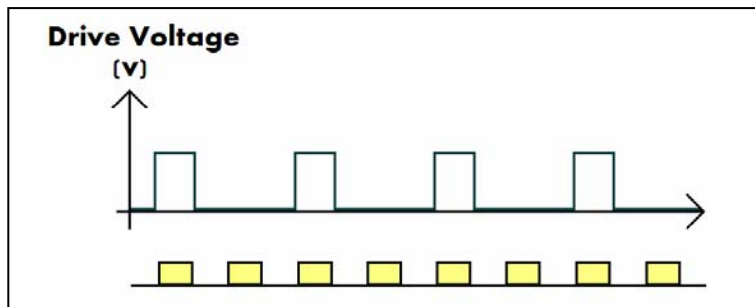
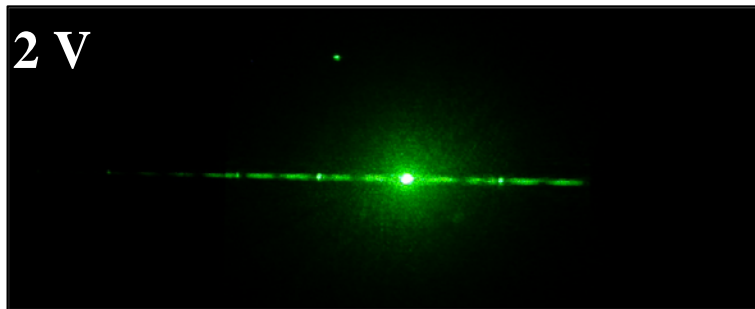
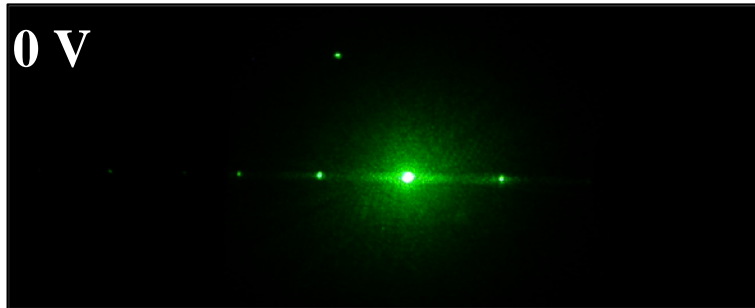


Maximum angle is dependent on the:

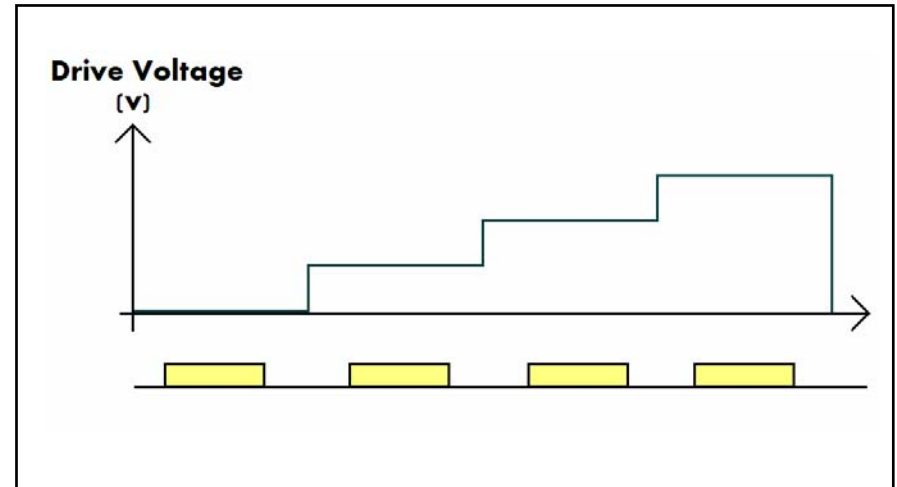
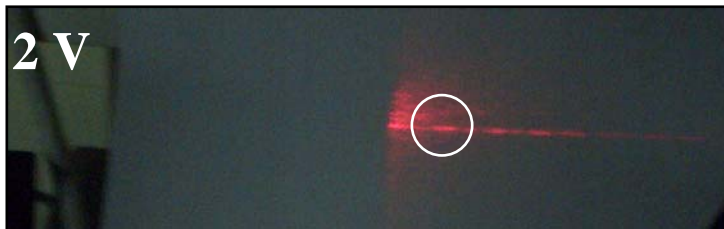
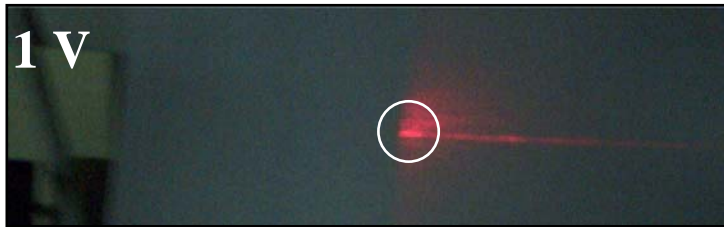
- Index difference (Δn)
- Thickness of the cell (d)
- Width of the pixel (w)



Preliminary result



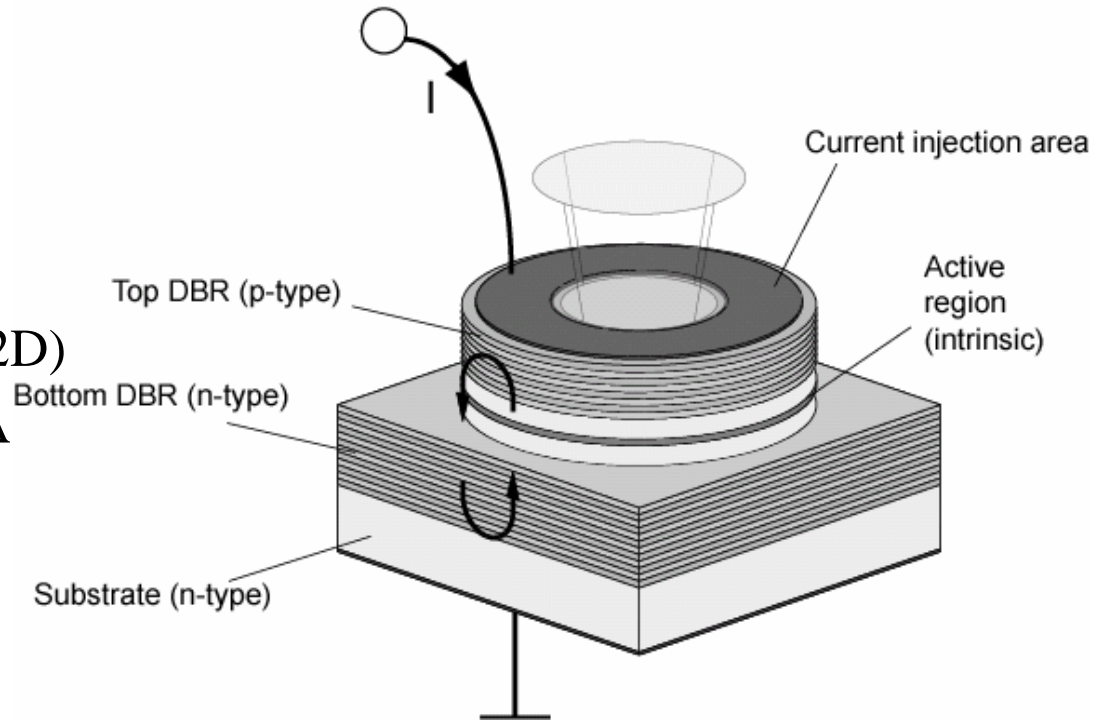
More Preliminary Results



The light source: The VCSEL

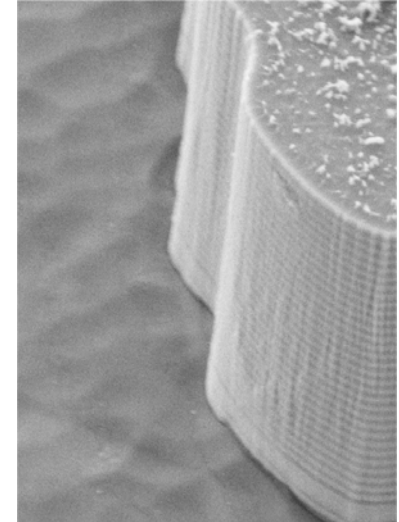
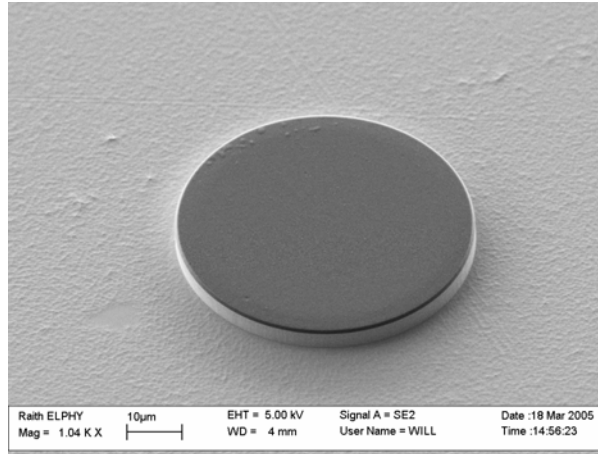
Properties:

- Device size $\sim 10 \times 10 \mu\text{m}$
- Surface emitting
- Array integration (1D and 2D)
- Threshold current $< 0.5 \text{ mA}$
- Power consumption $< 1 \text{ mW}$



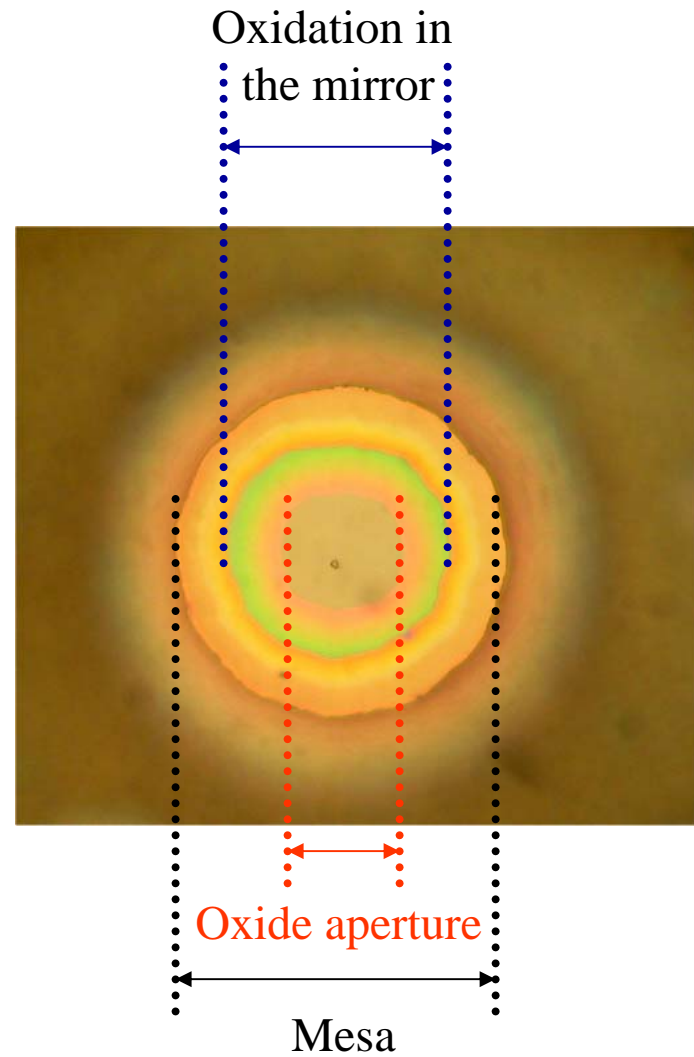
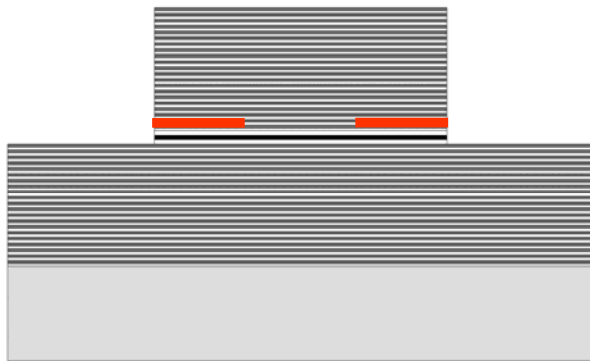
VCSEL =
Vertical Cavity Surface Emitting Laser

VCSEL – Mesa etch



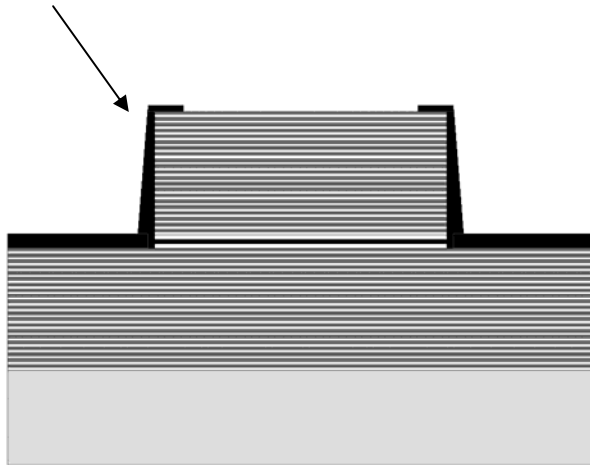
VCSEL – Oxidation

Oxidation with
water vapour

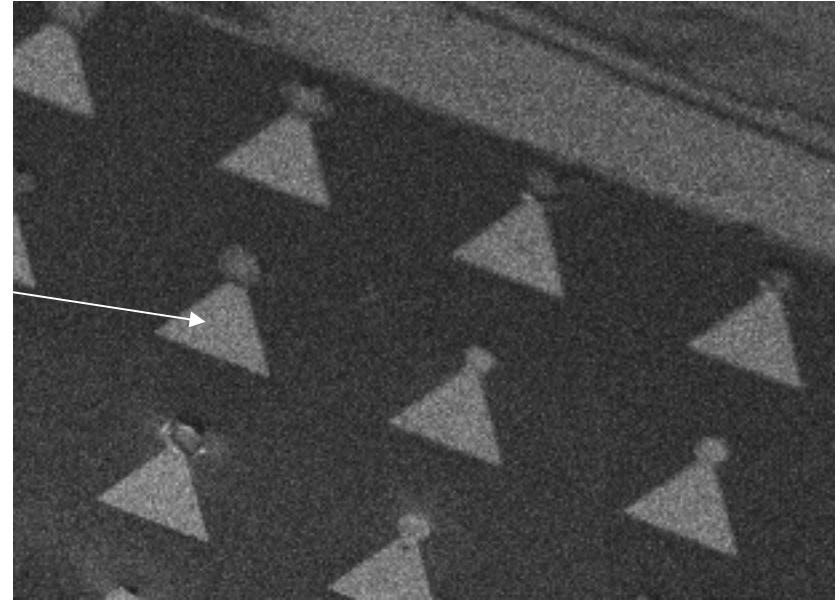


Insulation and Gold Contacts

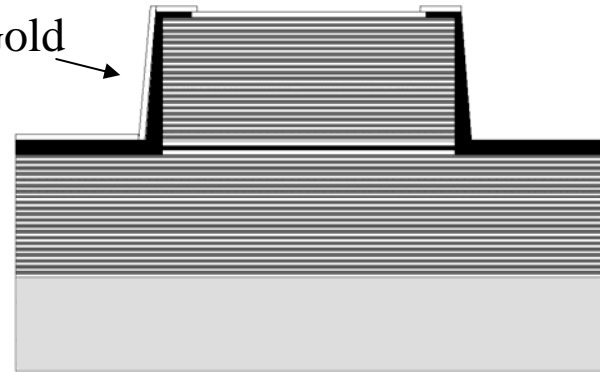
Hard baked
photo resist



Gold contact



Gold



Conclusion

