Automatisierte, hochpräzise Optikmontage Lösungen für die Industrie

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Trends in Micro Nano, HSLU, Horw, 5. Dezember 2013

High power laser sources

Motivation

- **Laser manufacturing** needs highly efficient and cost sensitive modules
- **Compact** systems searched
- Target: output of **100 W**
- Longterm vision: **10 $ / W**

Today's industrial offer

OCLARO's high power laser diode

- Fiber-coupled single emitter
- 80 W emission (in 105 μm fiber)
- 9xx nm wavelength

OCLARO™

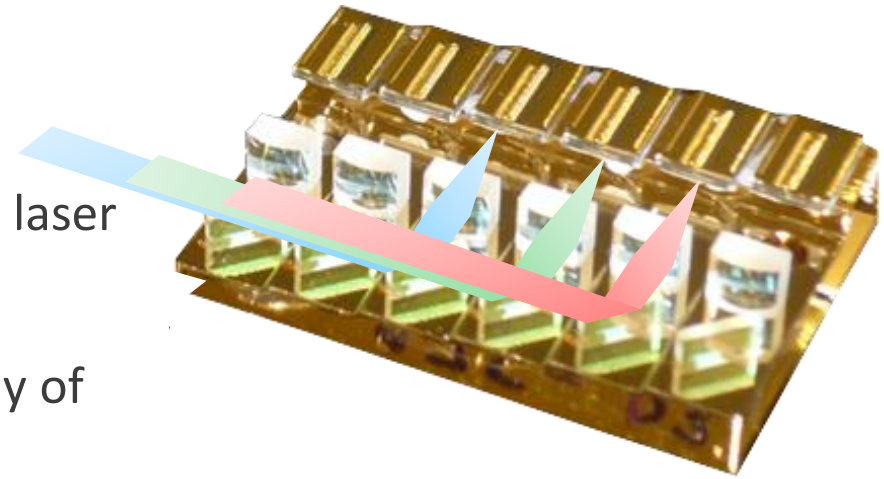
Applications

- Fiber laser **pumping**
- Direct diode material processing
- Medical applications

3 years ago: the way to implementation …

CSEM proposal

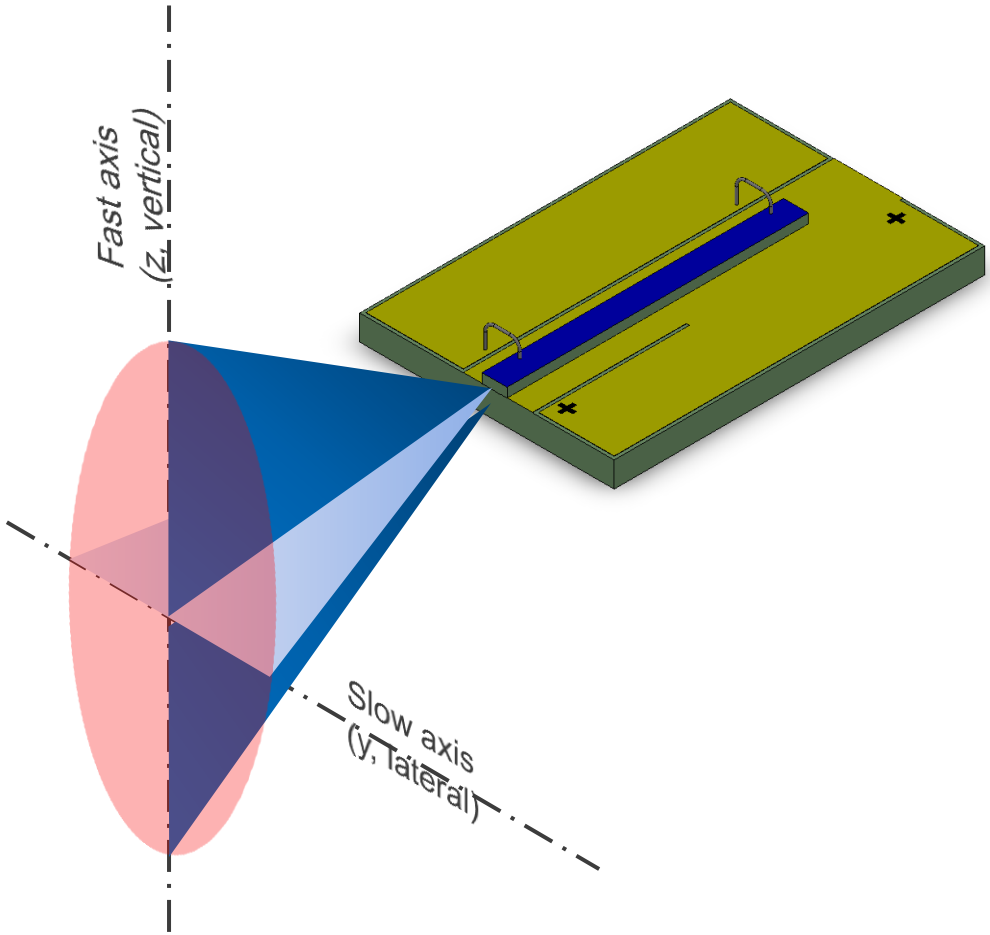
- Optical **design for assembly**
- **Combination** of beams from 12 laser diodes @ 10 W
- **Assembly** strategy and assembly of prototype
- **Assessment** of prototype



Laser diode with «fast» and «slow axis» emission

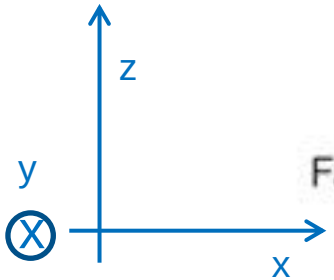
Laser emission

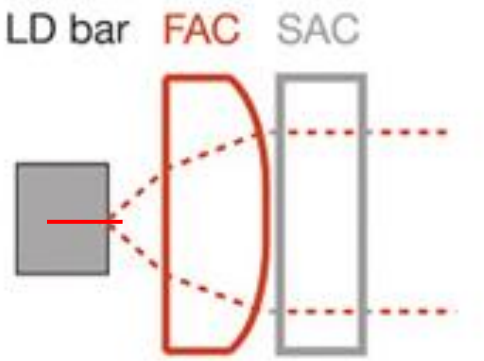
- **Fast axis:** large exit angle, sharp focus point => critical collimation lens alignment
- **Slow axis:** small exit angle, blurred focus => less critical lens alignment



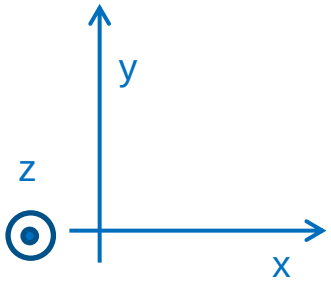
Fast axis collimation requires high alignment precision

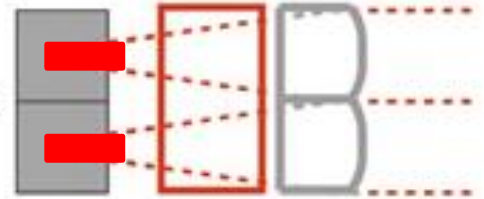
«side view»





«top view»



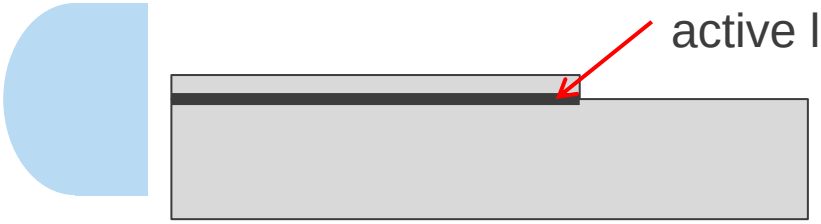


Alignment

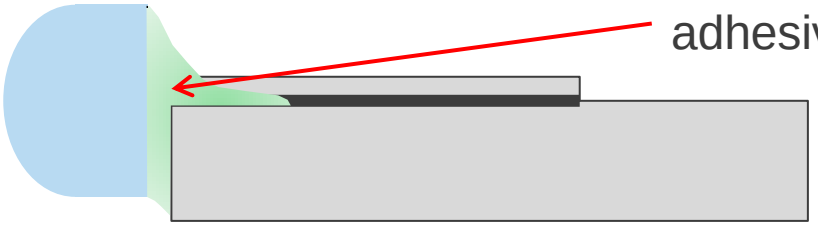
- **High sensitivity** of fast axis collimation (FAC) to mis-alignment
- **Alignment process** with sub micro-meter positioning accuracy in 5-6 degrees of freedom

FAC assembly without standoff

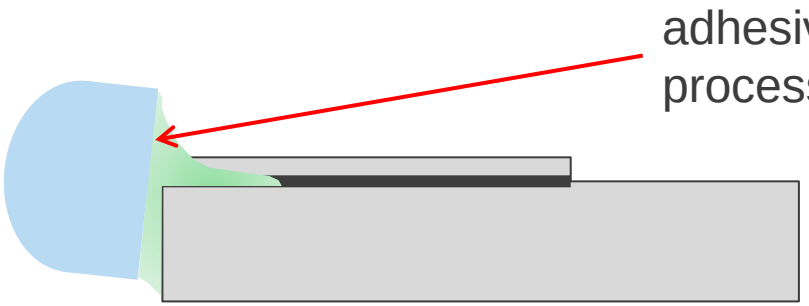
1. Lens alignment



2. Adhesive dispensing

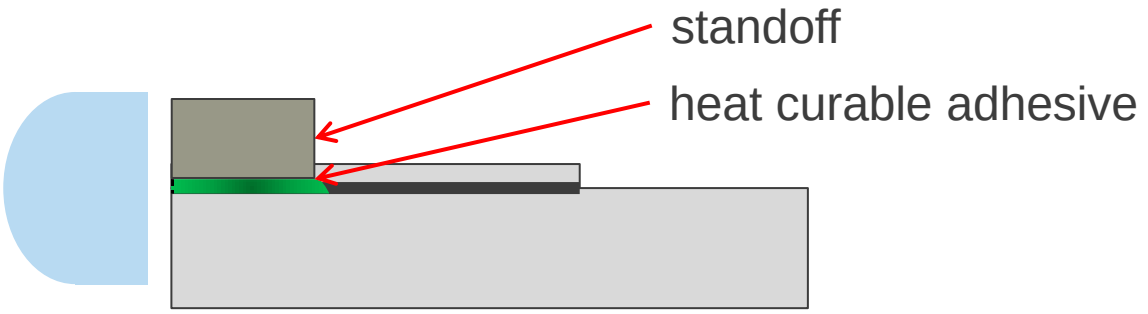


3. Adhesive curing

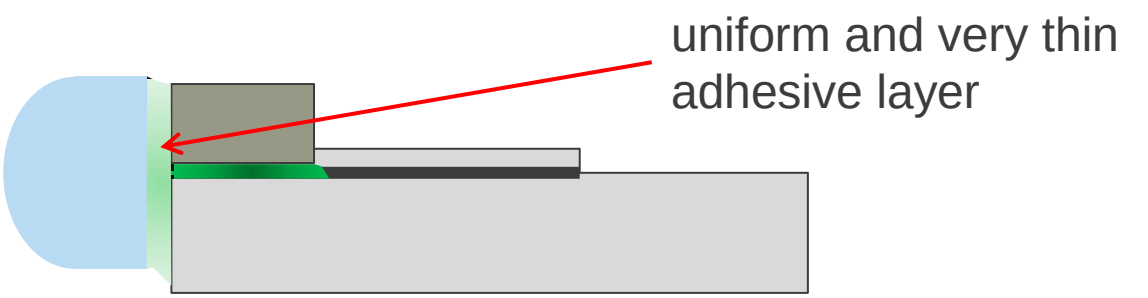


FAC assembly with standoff

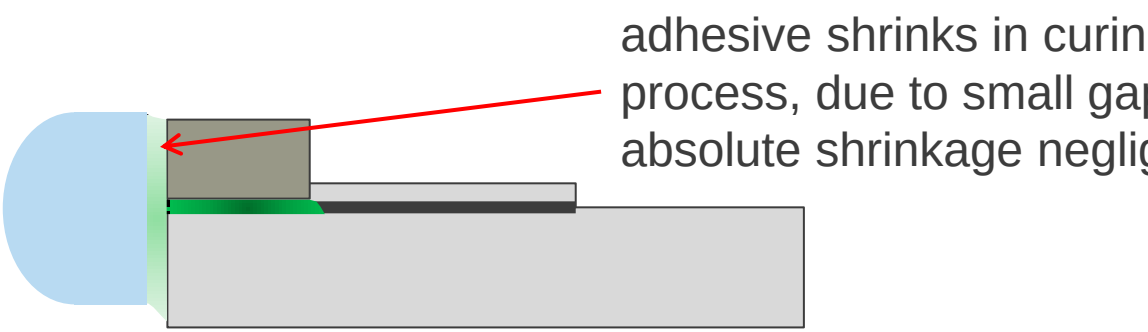
1. Lens alignment



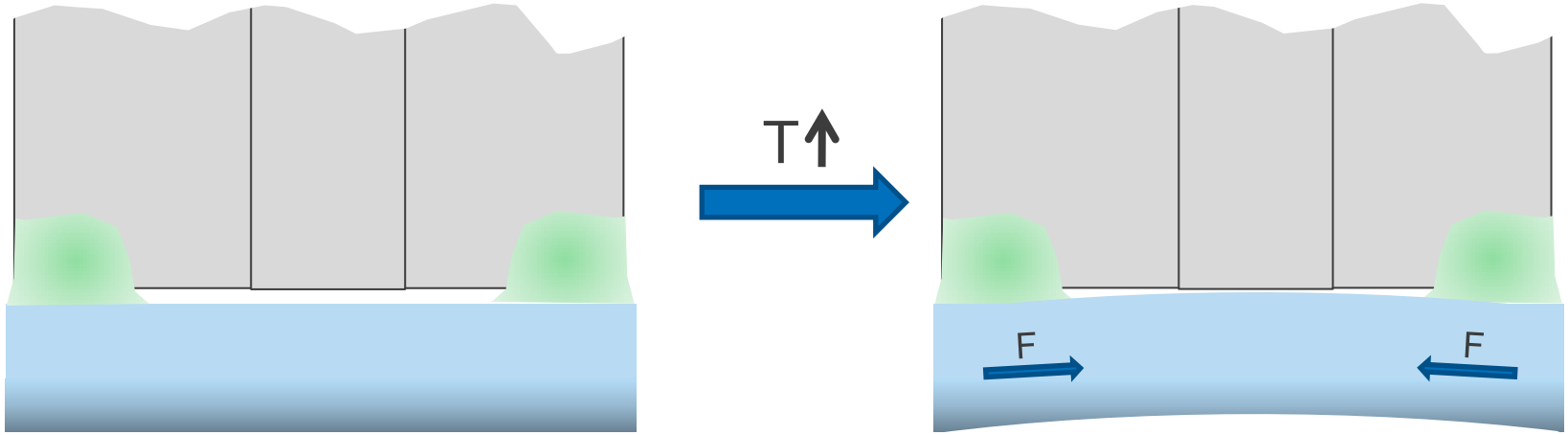
2. Adhesive dispensing

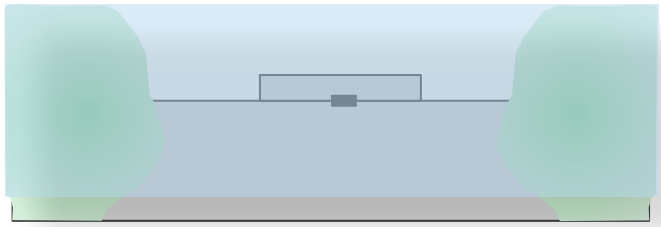


3. Adhesive curing



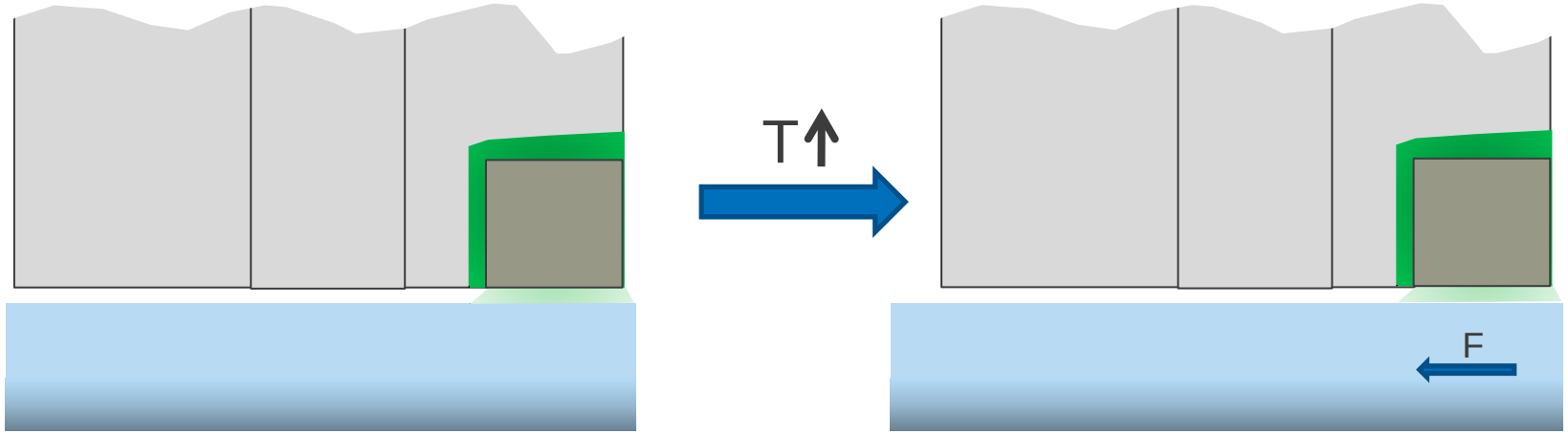
FAC assembly 2-sided adhesive bonding

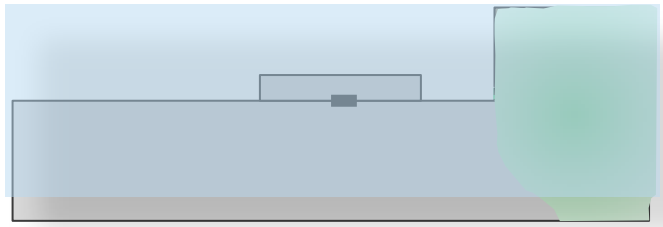




Due to adhesive bonding on two sides the lens will deform:
- while curing.
- at changing temperature.

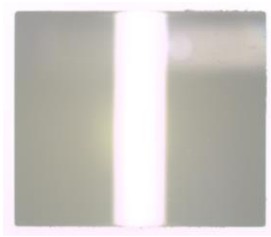
FAC assembly 1-side bonded with standoff





Due to adhesive bonding on one side the lens will expand. As it has no optical power in the „long“ direction the expansion has no effect.

Challenge: Quality of components

	Front view	Top view
Good lens		
Bad lens		

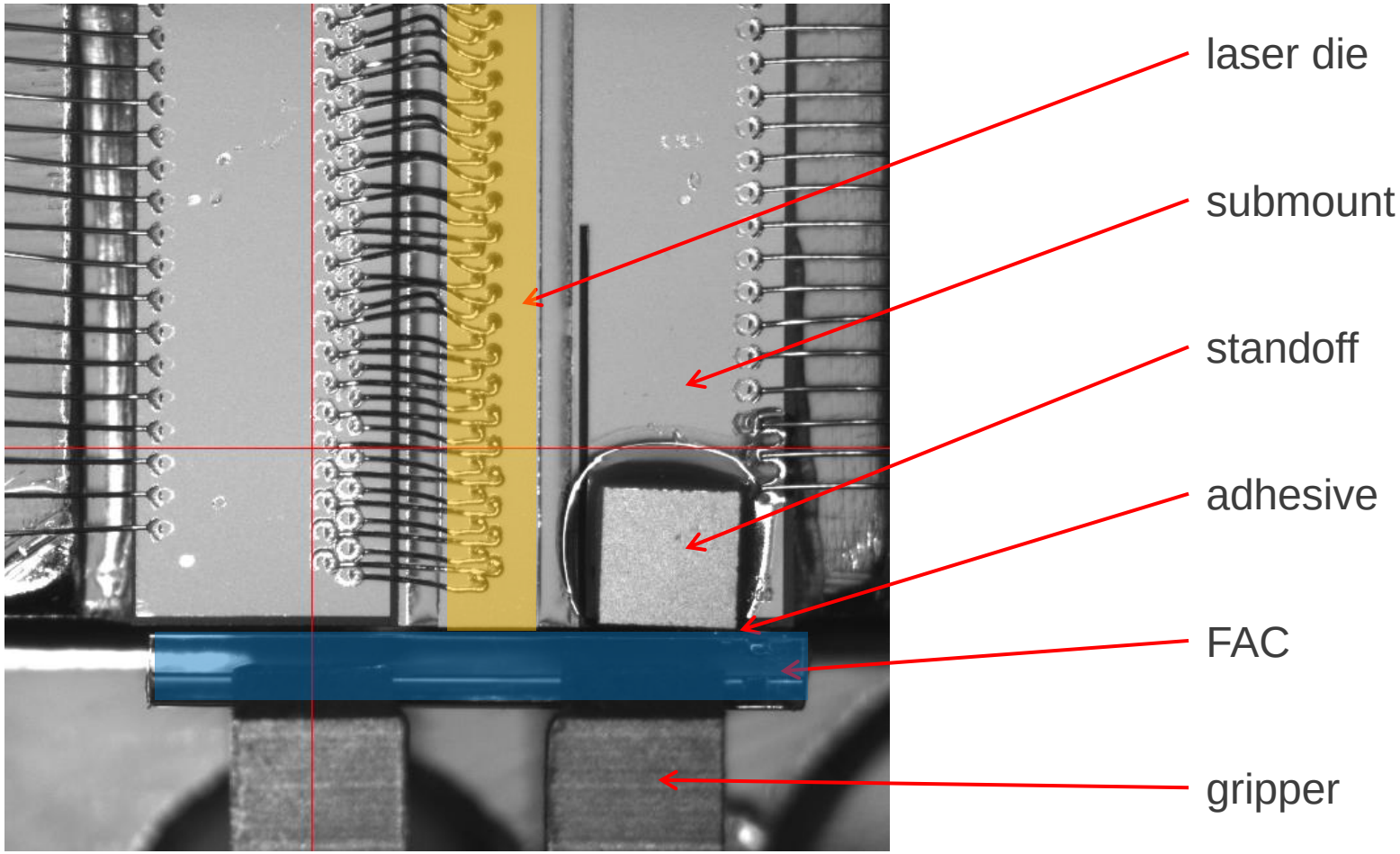
	Specified	Measured
Focal length [mm]	6.31 +/- 0.02	6.87 +/- 0.21
Radius [mm]	3.21 +/- 0.01	3.26 +/- 0.03

→Screening of 21 lenses (mechanical and optical characterization)

→ mechanical dimensions not as specified

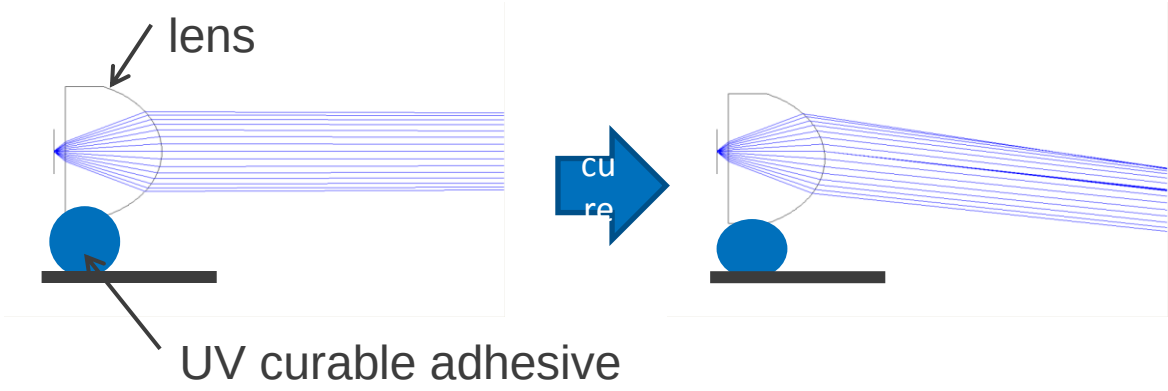
→Big difference in focal length

Top view on components



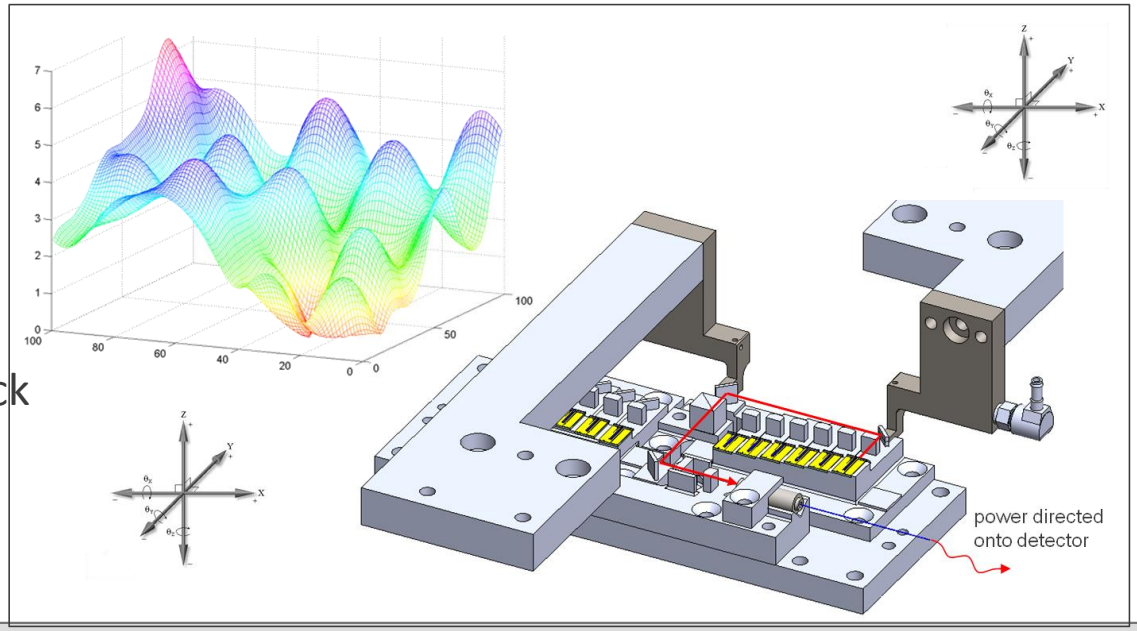
Critical process steps

- Dispensing
  - Reproducable droplets of nl volume (0.1 x 0.1 x 0.1 mm^3)

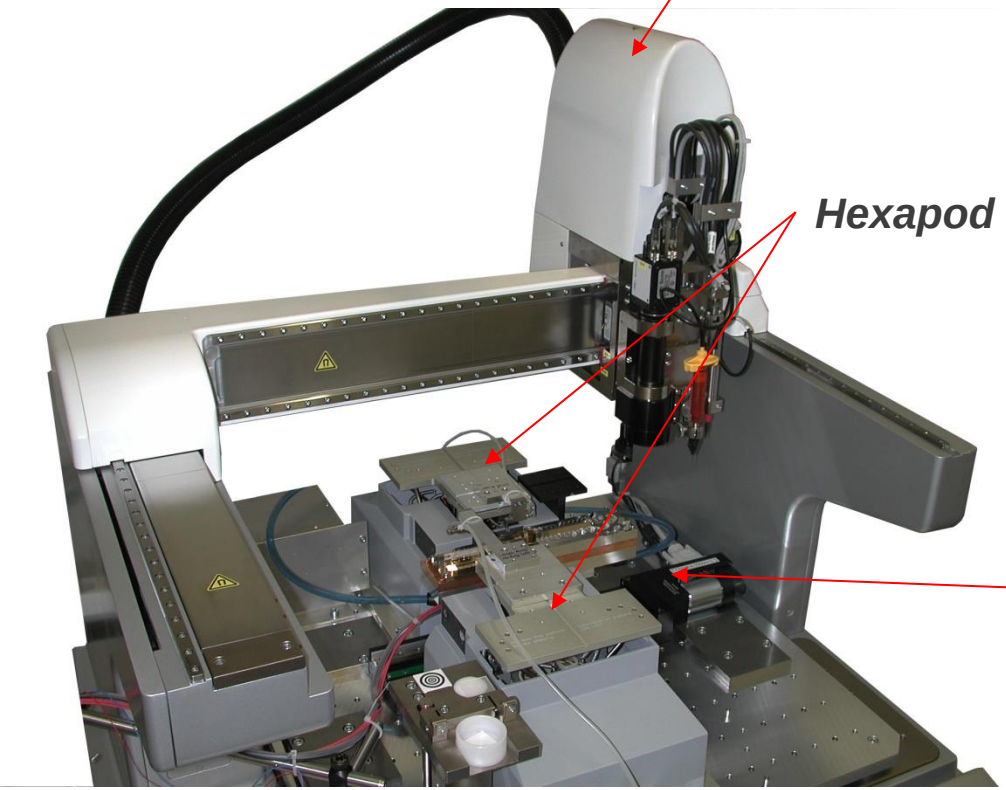


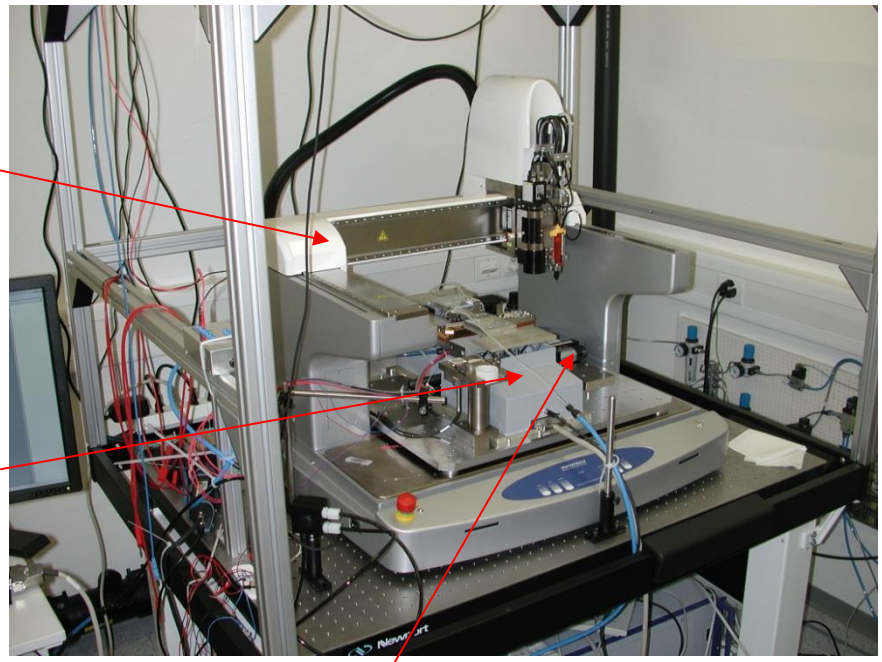
- Passive alignment
  - Camera based pre-alignment
    => accuracy several µm

- Active alignment
  - Alignment with optical feedback
    => accuracy several 100 nm



Assembly station overview





On shelf above setup (not shown) are: current driver, power meter, UV curing unit, dispenser control unit

Packaging @ CSEM

- Link to Video

- http://www.youtube.com/watch?v=iyKL6u4rDxo

Process development and automation

Industrialization

- Prototypes of **100 W modules** have been assessed and assembled for **Oclaro**
- Further extension to **400 W modules** is planned