The role of glass in the encapsulation of OLEDs

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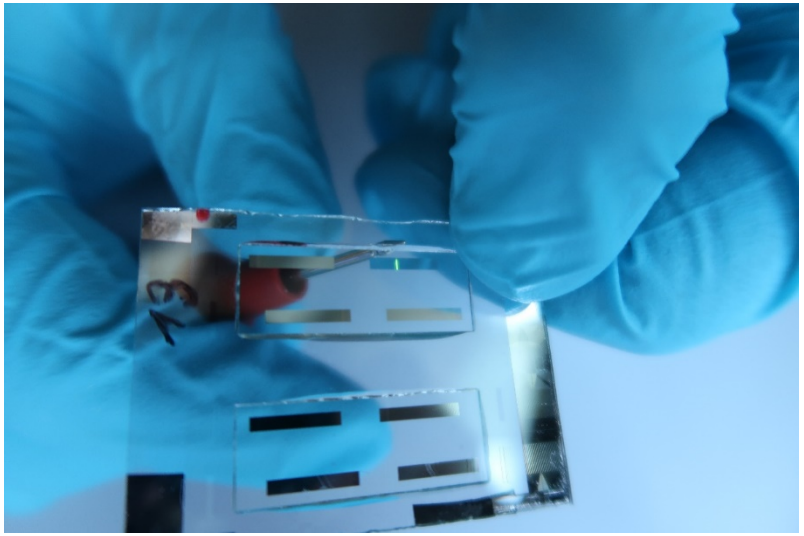

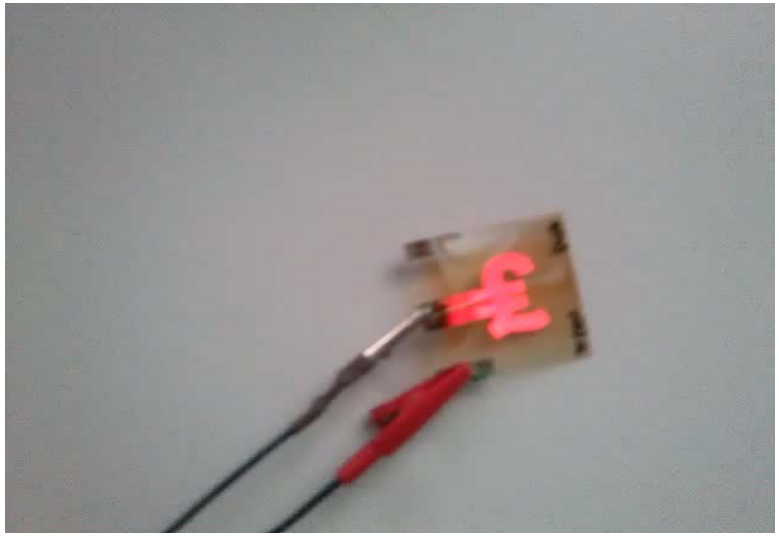

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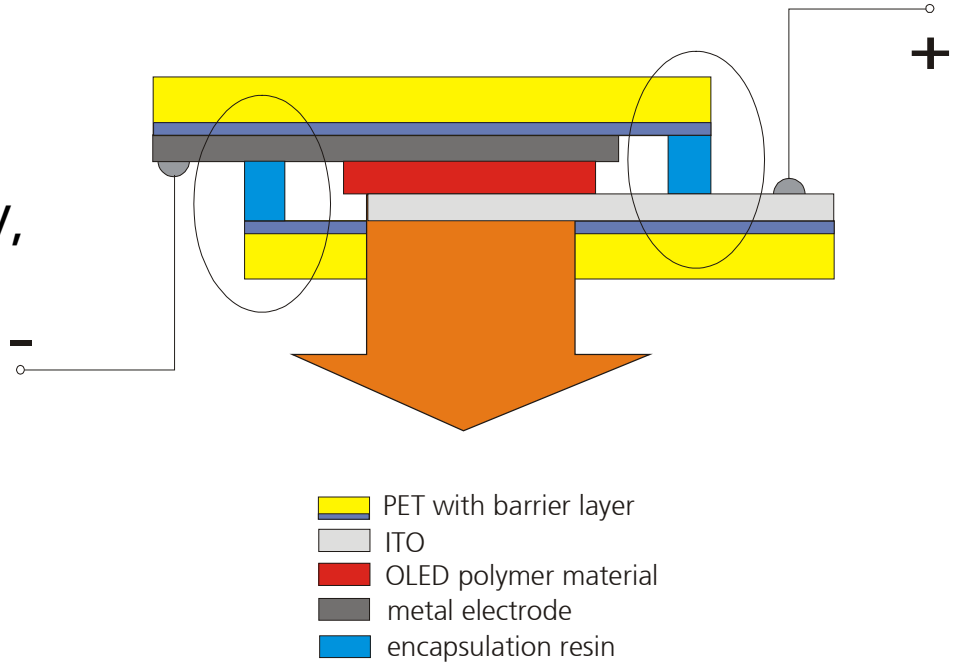
OLED - Organic Light Emitting Diode

- Self emitting device
- Current driven device,
lower than 1 mA/cm² @ about 3-10 V,
- Very thin and flexible possible,
- High color gammut,
- High brightness up to 50.000 cd/m²



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OLED technology development with industrial partners

Advantages

- Moderate developing costs
- Lower production costs (also printing)
- Small and medium quantities
- Segmented colored signage
- Ligthting

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OLEDKEY®
OLED and key functionality for
a coffee machine

Prototypes

Switches and Keys

Signage

Illumination

Automotive

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Prototypes

Switches and Keys

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OLED lamp for Illumination

Prototypes

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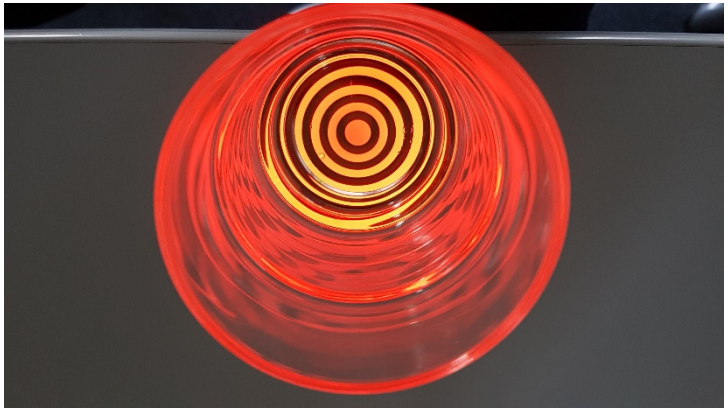

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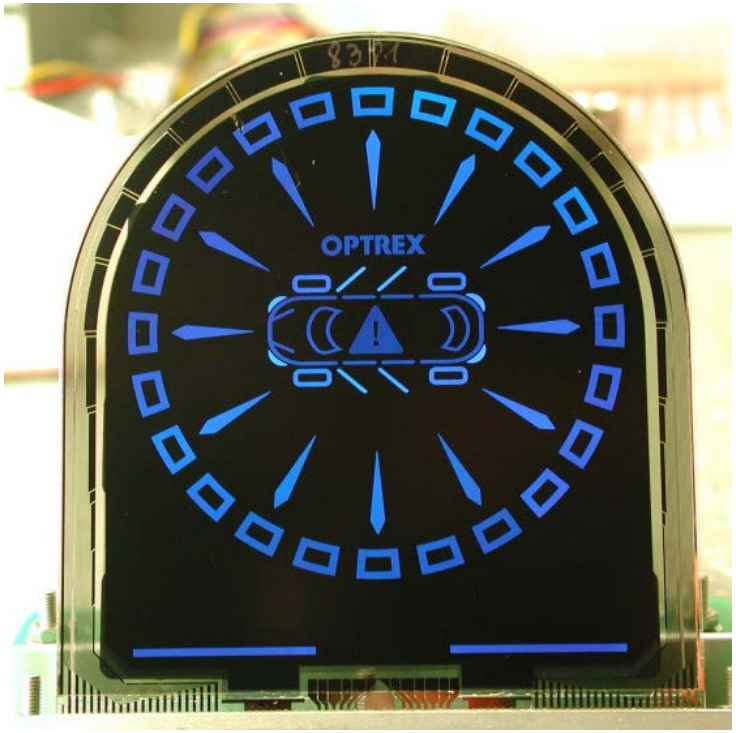

Prototypes

Switches and Keys

Signage

Illumination

Automotive

OLED for automotive applications

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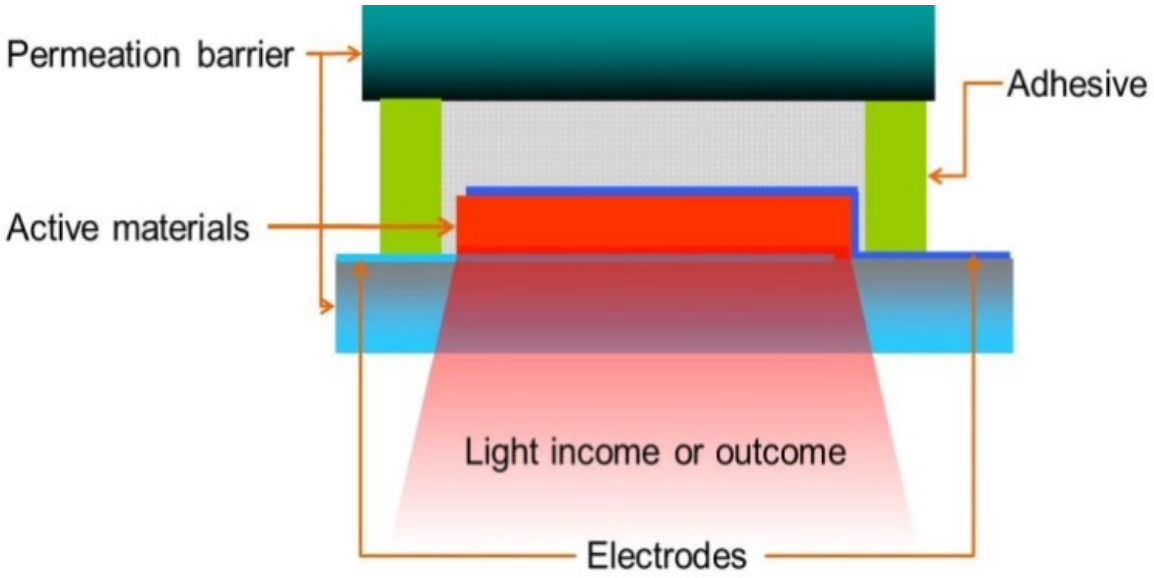
- OLEDs are suitable for surface lighting
- OLEDs are suitable for areal structured signal displays
- OLEDs are also suitable for passive and active matrix displays
- OLEDs can also be transparent
- OLEDs will also be flexible in the future
- OLEDs are infinitely dimmable

Development of encapsulation material/ process for long lifetime device

Permeation pathways



➡ General set-up of an encapsulated device

Development of encapsulation material/ process for long lifetime device

Degradation Possibilities

The degradation mechanisms are determined by different interfaces between OLED and the encapsulation materials:

Active Layer – OLED stack (materials degradation)

Electrodes (very sensitive against oxygen and moisture, e.g. Ca)

Permeation through the adhesives (resin or tape)
- adhesives with absorber

Permeation through Interfaces (pre-treatment)
- surface treatment

Reverse Permeation
- study of materials in the OLED stack

From Lab Scale to Pilot Scale

- Goal: Increase of reproducibility and reliability of devices through transition from lab scale to pilot scale
- Up-scaling of device processing
- Needed
  - Clean atmosphere during deposition of thin layers
  - Reproducible deposition techniques
  - Reliable encapsulation techniques

- Installation of a S2S pilot line for organic electronics (OLED) including efficient printing and processing steps

Clean Room in the Application Center

Fraunhofer IAP application center combines printing technologies
in a continuous process flow for medium size substrates (150 x 150 mm²)

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Module A

- Înkjet printer for two inks
- Slot-Die coater for two inks

Linear robot handling of substrates of 150 mm x 150mm

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- **Module B**
  - 3 thermal evaporation sources with the ability of co-evaporation
  - E-beam evaporation source
  - Laminar flow for the reduction of particle contamination during filling and opening of evaporation chamber
  - Mask change under vacuum for up to five masks
- In module B the substrate handling is manual

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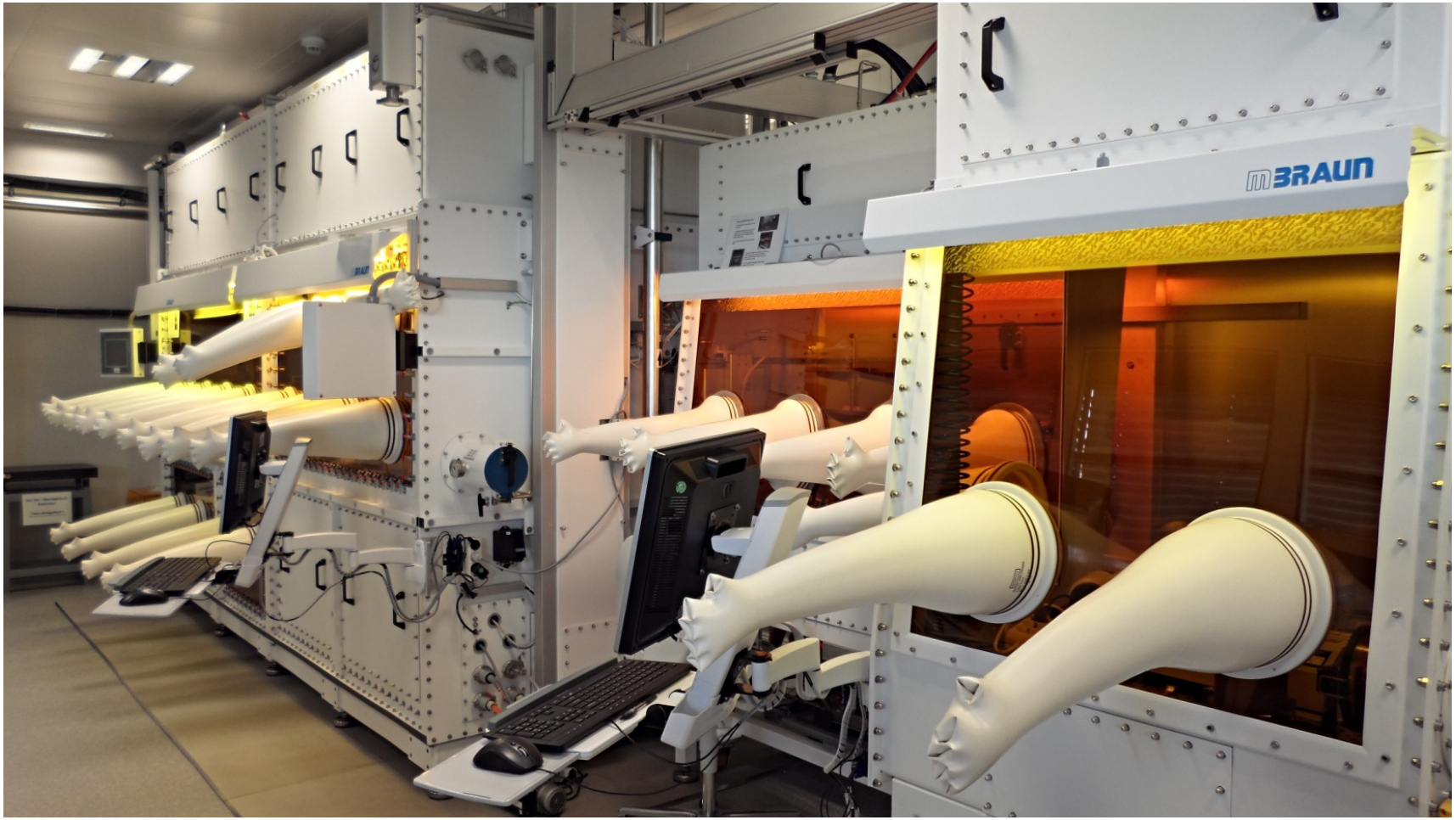
Module B



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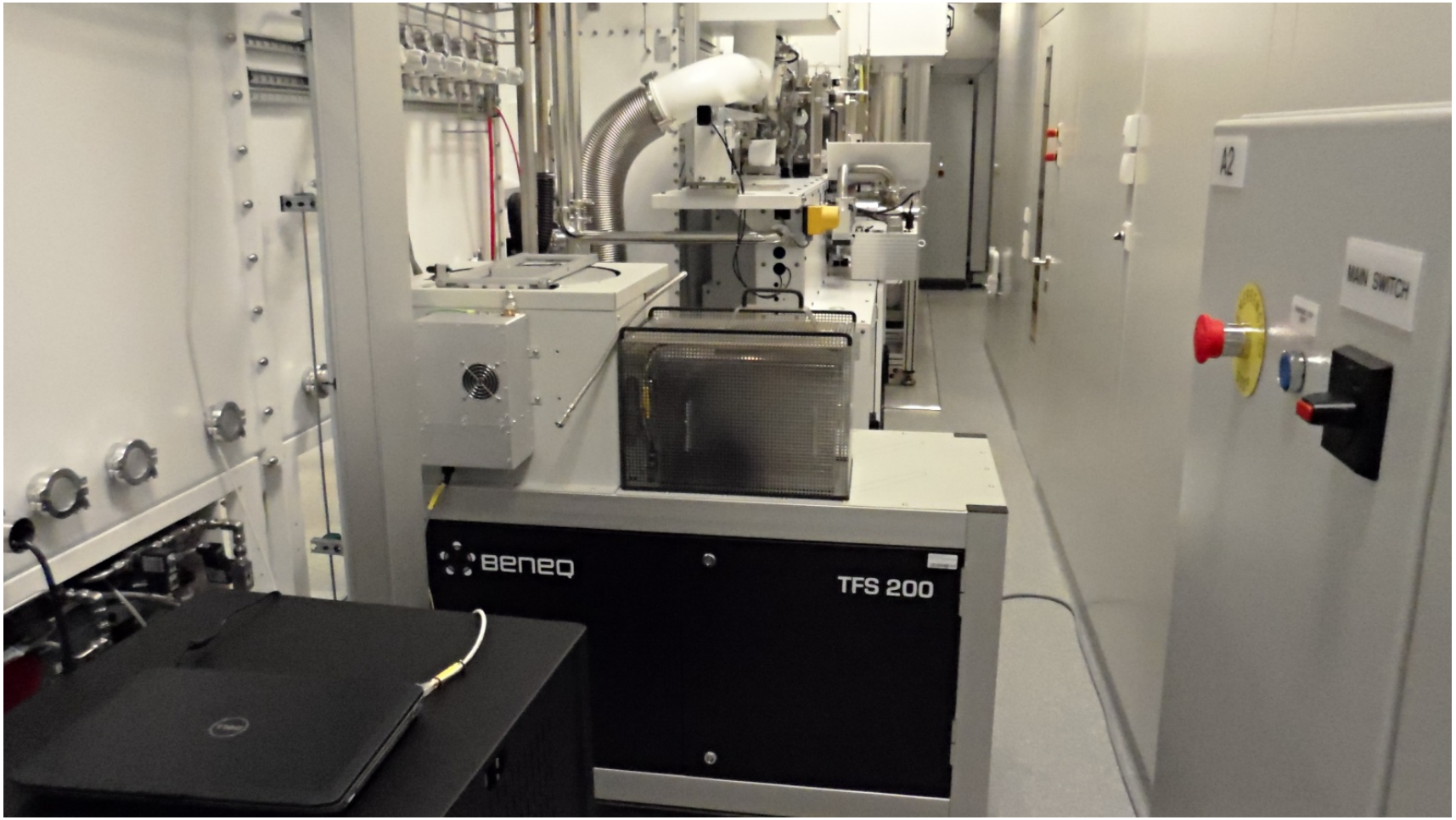
- **Module C**
  - Getter/Dispense system for encapsulation of devices
  - UV press for curing of encapsulants
  - Heated transfer chamber with vacuum oven (up to 250 °C) for removing of water from materials before the transfer into the inert systems
  - ALD tool for direct encapsulation and buffer layers
- In module C two different encapsulation tolls are installed: getter/dispense systems for adhesive based encapsulation (glass/plastic). In addition the ALD enables a direct thin film encapsulation of active devices.

New application center – S2S Pilotline at Fraunhofer IAP

Module C



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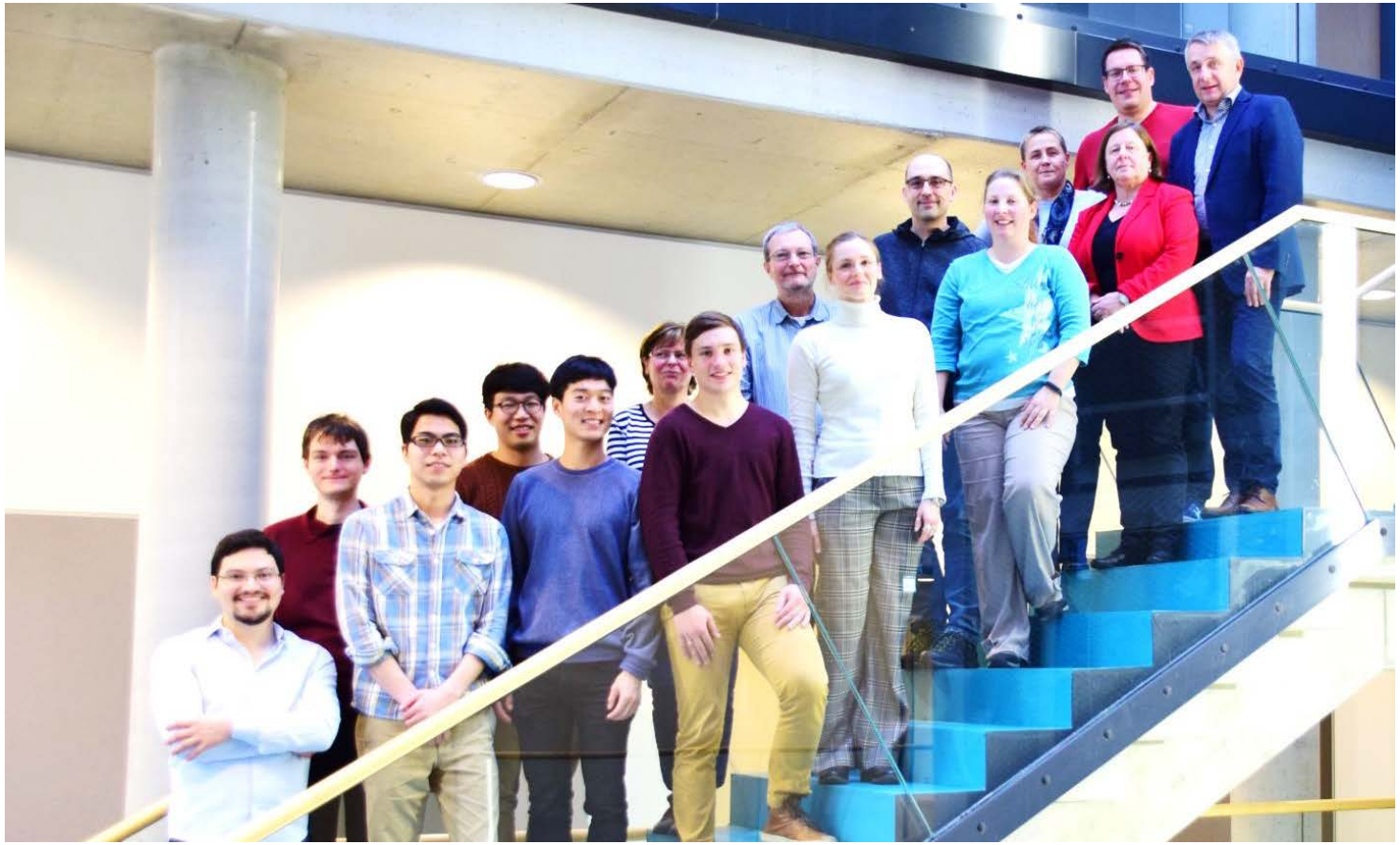
Acknowledgement



Thanks for your attention!