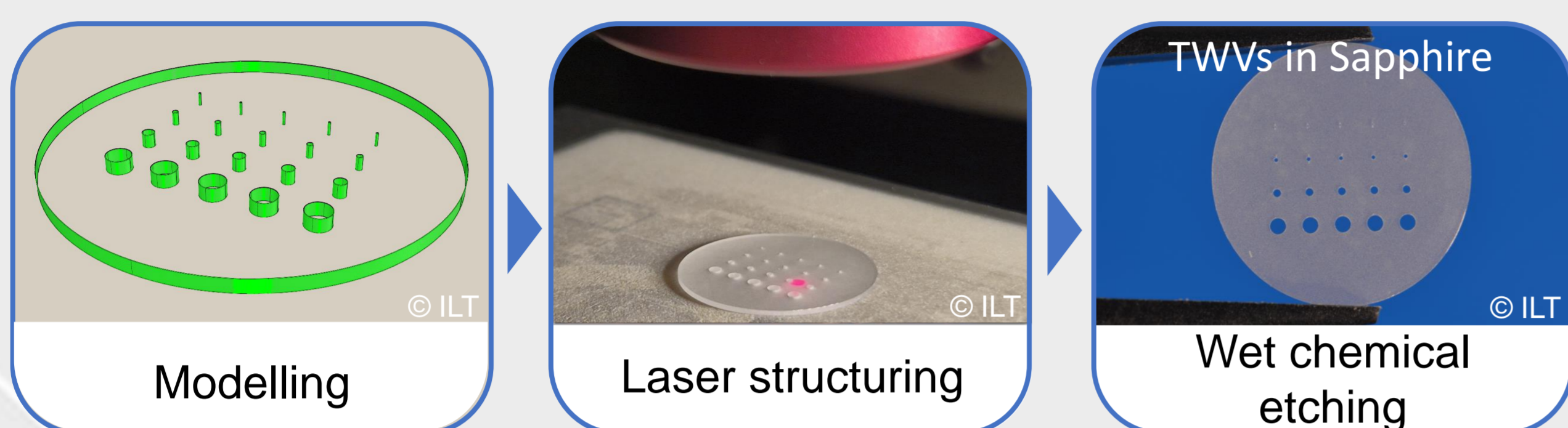


Photonics in glass

Selective laser-induced etching (SLE) and packaging

1 Selective Laser-Induced Etching (SLE)



SLE-Process for creating 3D structures from transparent dielectrics (for example: fused silica, BOROFLOAT, sapphire)

1. Modeling

- Slicing of the CAD model and calculation of laser vectors along the component surface

2. Laser structuring

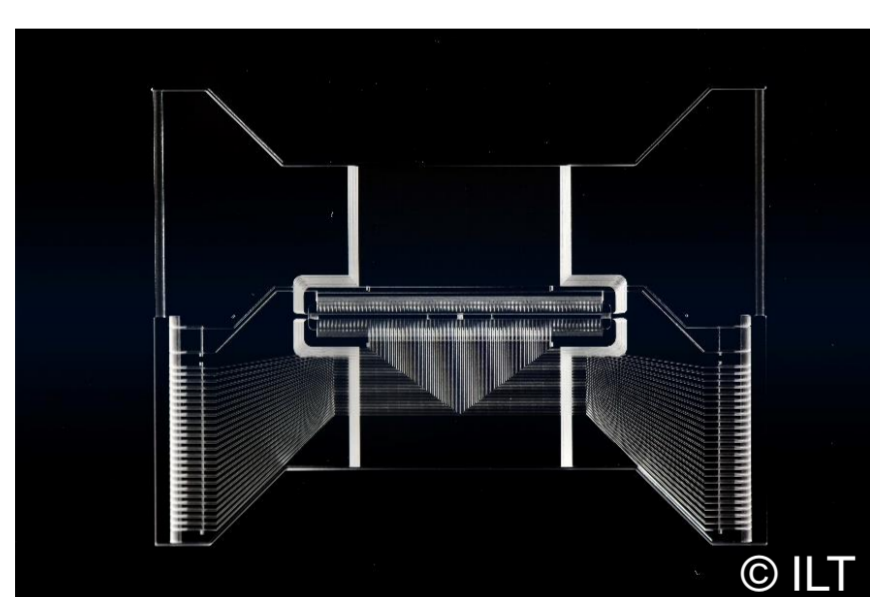
- Structuring of modification lines within the transparent material using tightly focused USP laser radiation

3. Wet chemical etching

- Etching of the modified areas using KOH or HF

2 Special features & application examples

- Almost unlimited **freedom of geometry**
- High precision ($<1 \mu\text{m}$)
- Surface roughness:
 - After SLE: $S_a < 1 \mu\text{m}$
 - After laser polishing: $S_a < 10 \text{ nm}$
- High degree of **flexibility** (digital process)



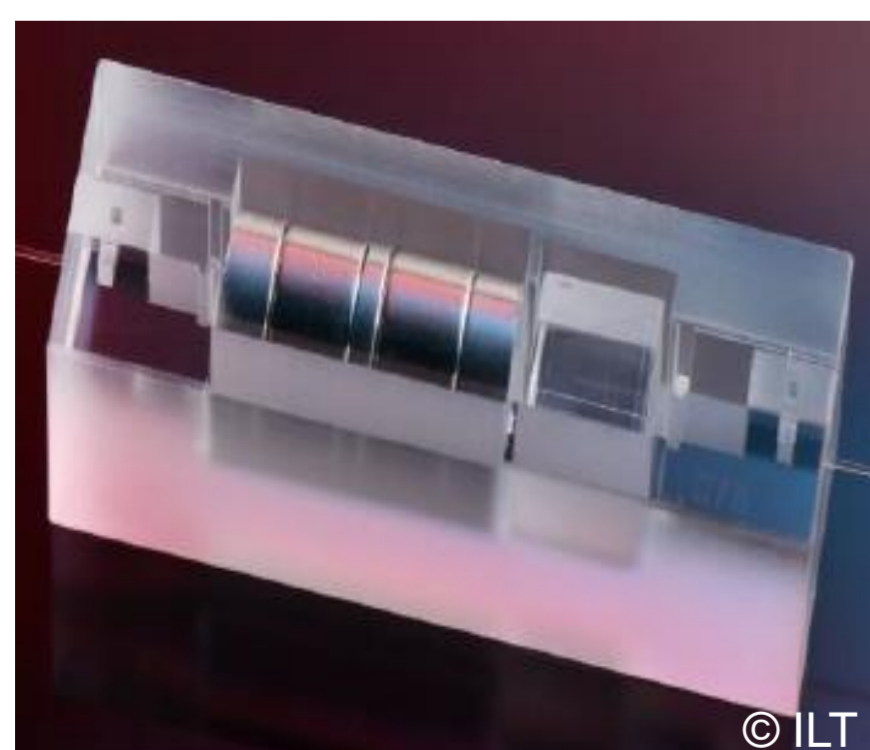
Ion traps (ATI)

Glass-based ion traps with **in-volume structuring** (undercuts) and three-dimensional electrode design.



Microresonators (LAR3S)

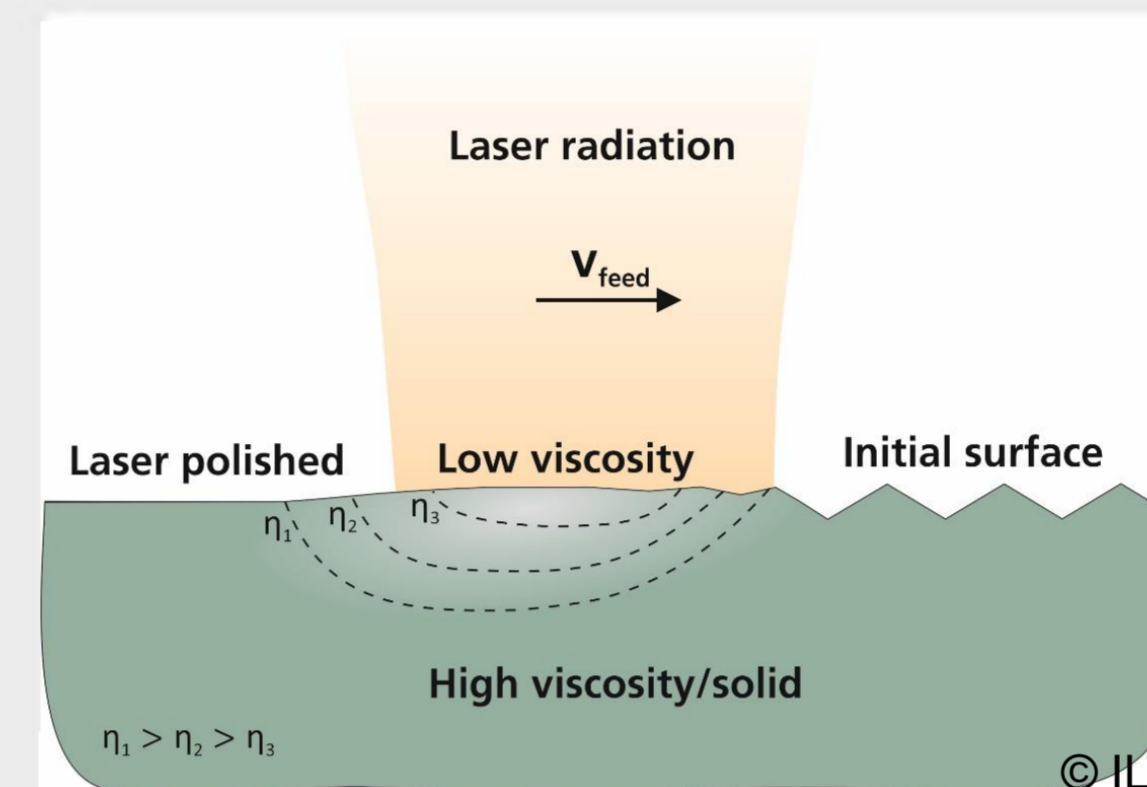
Glass structures with **low surface roughness** for storing light of specific wavelengths. The dimension of the structure is $\sim 100 \mu\text{m}$ (disc) to $\sim 50 \mu\text{m}$ (base).



Fiber chip coupler (HIPEQ)

Optical connection element with fiber clamp and holder for the installation of micro-optics. The dimensions of the component are $2.85 \times 1 \times 1 \text{ cm}^3$ with a **fabrication tolerance** of $<200 \text{ nm}$ (optics mounts).

3 Combined process SLE + glass polishing



- Absorption of laser radiation close to the surface ($< 30 \mu\text{m}$)
- Local reduction in viscosity leads to **redistribution of material** due to its surface tension

➤ **Ablation-free polishing process**

Areas of application:

- Polishing of ion trap electrodes to reduce background noise
- Production of optical components (e.g. special/micro-optics, integrated optics)

SLE fabricated lens:

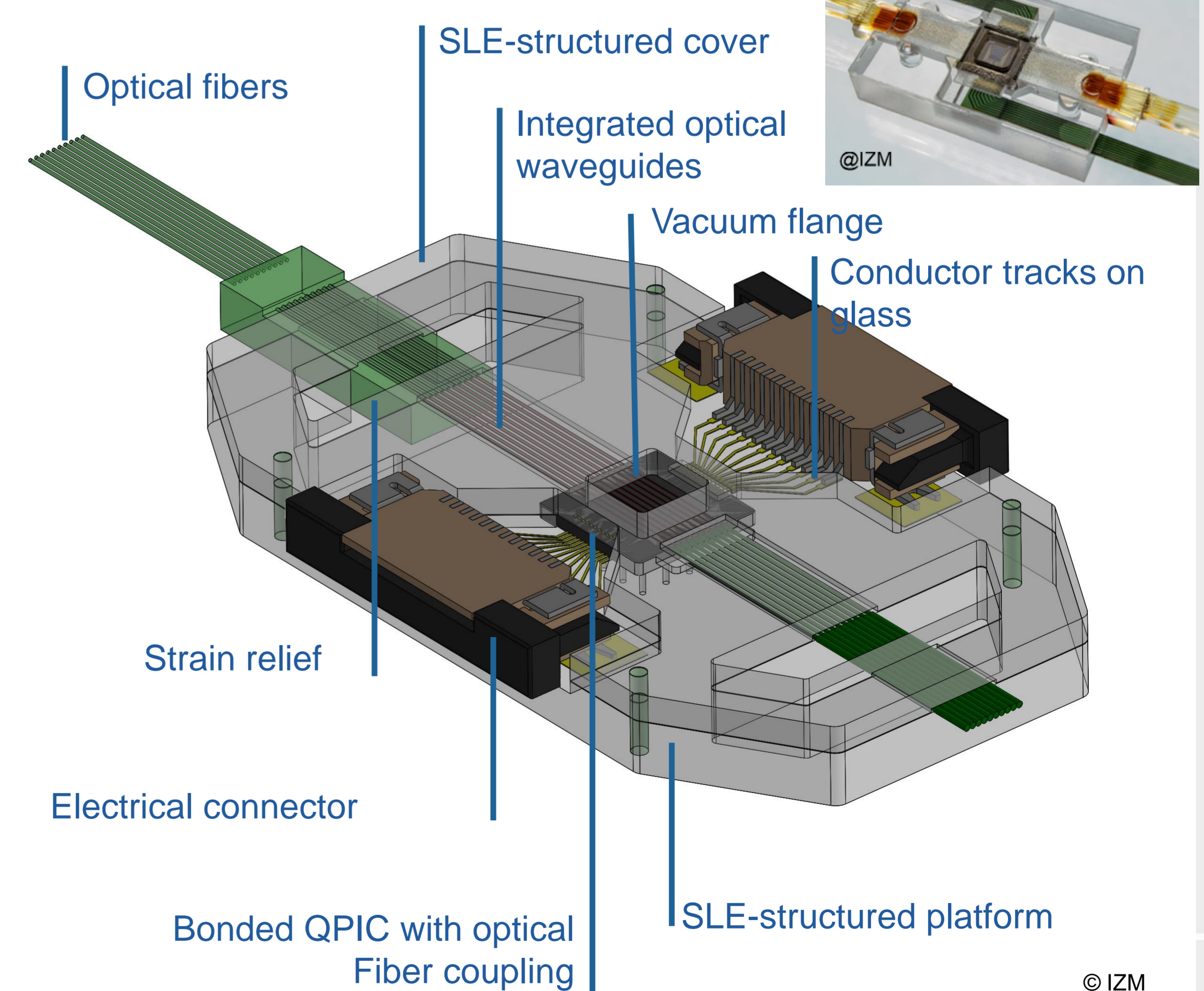


After CO₂ polishing:



4 Generic test packaging platform

Quantum photonic PIC (QPIC) must be optically and electrically contacted and often connected to vacuum recipients. A glass-based **test platform** is offered for the development stage. The final product package can later be manufactured in quantities using the same technologies and a reduced form factor.



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