LPKF Laser & Electronics

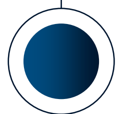
German Corporate Conference 2024

TOMORROW'S TECHNOLOGY TODAY

24 September 2024 | Dr. Klaus Fiedler, CEO | Christian Witt, CFO

LPKF Laser & Electronics

GLOBAL PLAYER



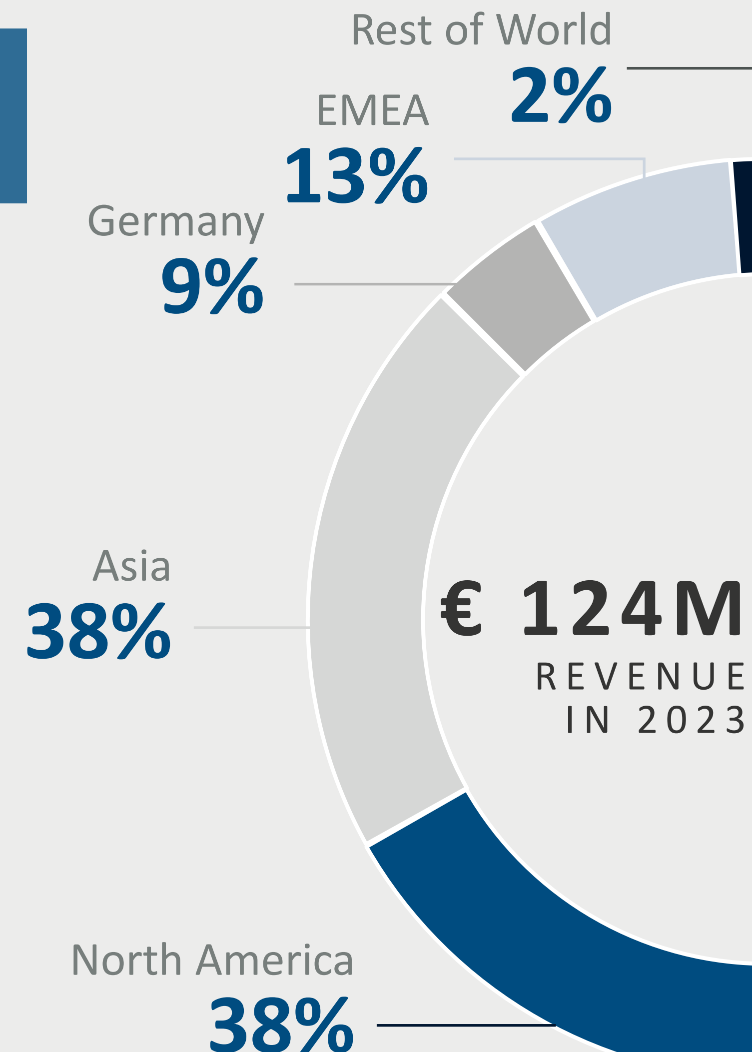
LPKF is a globally active technology company based in Garbsen, Germany. Our expertise is in the fields of precision laser processing, microsystems technology, application know-how, and software together with training and professional support. Investing in the development of innovative processes provides our customers with competitive advantages and open up new growth markets.

>45 years of experience

>750 dedicated employees

>10% of revenue invested in R&D

Active in **>70 countries**



GROWTH STRATEGY: CONSISTENT APPROACH ACROSS BUSINESS UNITS

LPKF Laser & Electronics

GROW THE CORE

Superior customer benefit through sustained technology advantage → **gain share**

Focus on growing application fields → **Increase addressable market**

Active product portfolio management to avoid commoditization → **sustain margins**

Serviceable Addr. Market
EUR 350 million

Ø Annual Growth Rate
8%

EXPAND INTO NEW MARKETS

Leverage core competencies to enter new markets with disruptive solutions

Focus on scalable business opportunities

Proactive approach to secure core IP and first mover advantage

Serviceable Addr. Market
EUR 1.4 billion

Ø Annual Growth Rate
17%

OUR MANUFACTURING & LIFE SCIENCE SOLUTIONS

LPKF Laser & Electronics

ELECTRONICS
SURFACE-MOUNT TECHNOLOGY

DEVELOPMENT
IN-HOUSE PCB PROTOTYPING & MICRO MATERIAL PROCESSING

WELDING
PLASTICS WELDING

ELECTRONICS
GLASS MICRO PROCESSING

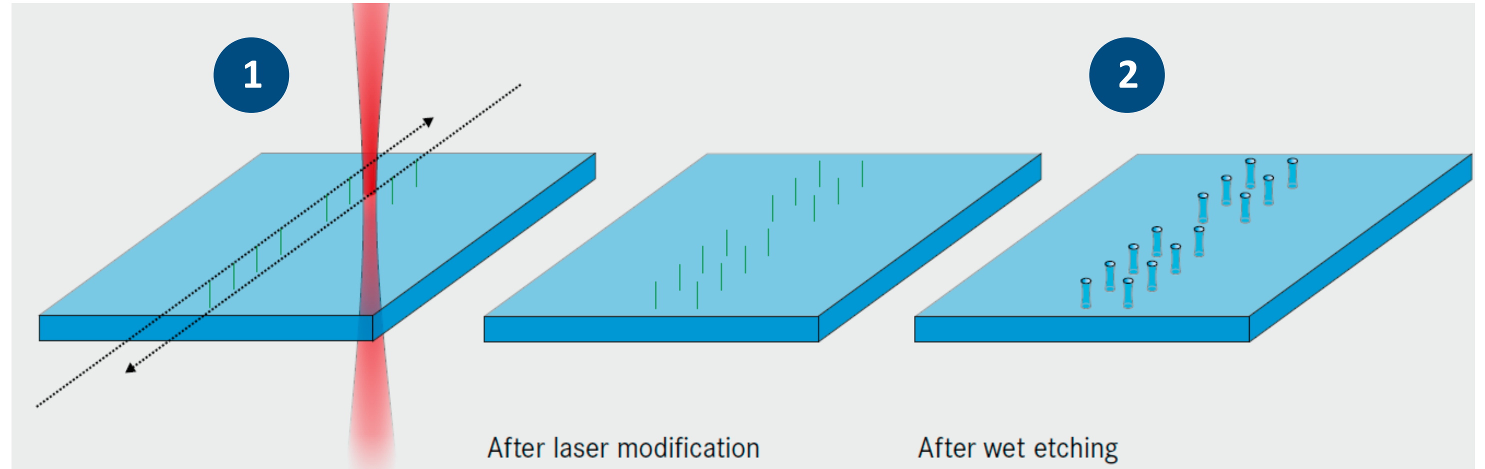
DEVELOPMENT
SINGLE CELL BASED RESEARCH & APPLICATIONS

SOLAR
THIN-FILM LASER PROCESSING

LASER INDUCED DEEP ETCHING: HOW IT WORKS

LASER PROCESSING

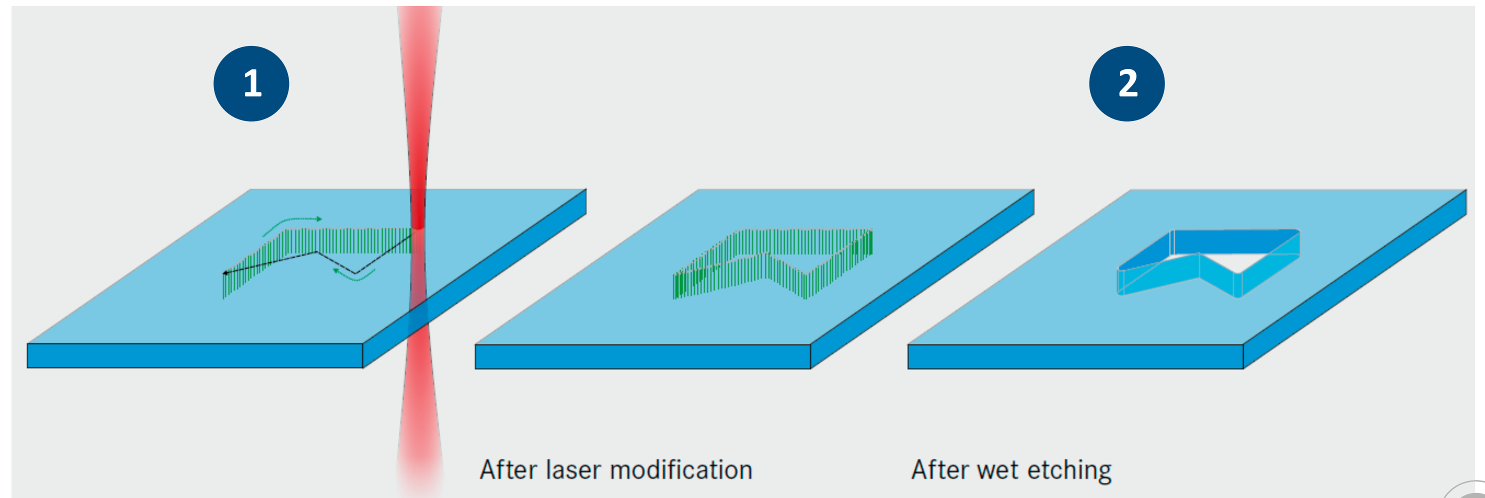
- In the **first step**, glass of **up to 1mm** can be structured by a **single laser pulse**. Pulse positioning accuracy is >5µm Cp >1,33.



Micro-Drilling

ETCHING

- In the **second step**, the laser structured substrates are wet etched.
- The laser-modified regions display a much higher etch rate than the bulk material.
- The result is the formation of hourglass shaped holes with a tunable taper.



Micro-

LIDE IS SUPERIOR TO OTHER GLASS PROCESSING METHODS

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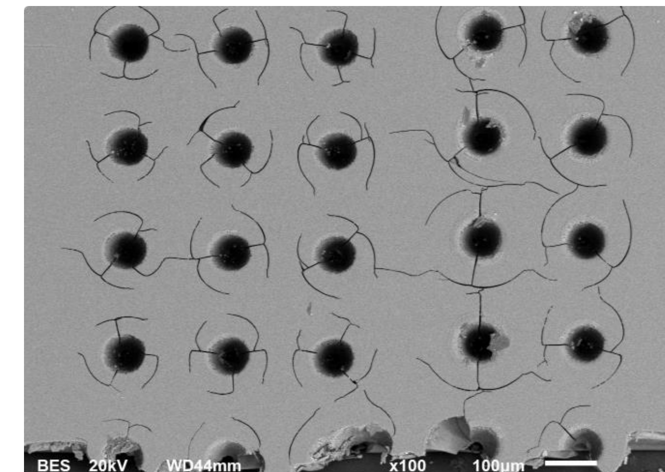
CONVENTIONAL LASER GLASS PROCESSING

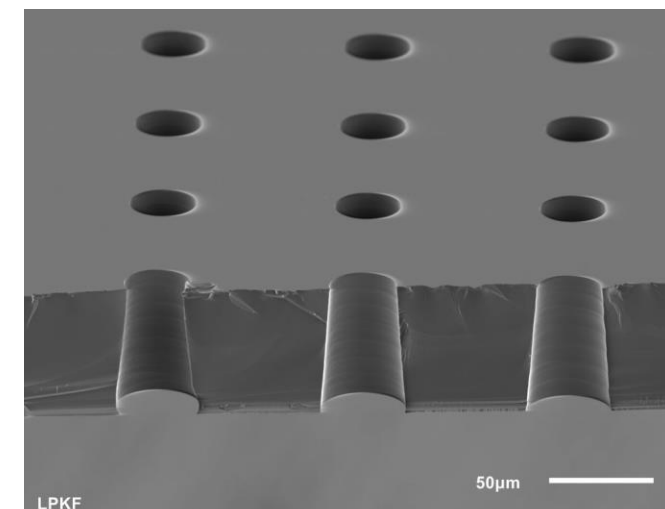
Conventional glass processing limits the application of glass due to:

- This (Micro) cracks
- Chipping
- Thermally induced stress
- Low accuracy
- Low reproducibility and yield
- Debris and vapors
- Limited aspect-ratios



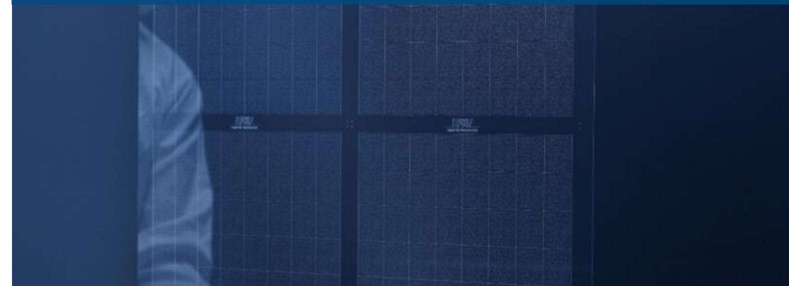
LIDE: MICROCRACK-FREE PROCESS

LIDE generates highly accurate and defect free microstructures in glass in a cost-effective manner.



LIDE HAS A WIDE RANGE OF APPLICATIONS

Laser & Electronics



CHANGE STARTS FROM THE TOP

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intel

"After a decade of research, Intel has achieved industry-leading glass substrates for advanced packaging. We look forward to delivering these cutting-edge technologies that will benefit our key players and foundry customers for decades to come."

–Babak Sabi, Intel senior vice president and general manager of Assembly and Test Development

Tech News: TSMC Advances into Panel-Level Advanced Packaging Technology

SMYG LIMITED
1.061 Follower:innen

21. Juni 2024

In response to the burgeoning demand for advanced packaging technologies driven by AI applications, TSMC is gearing up to introduce a breakthrough in its packaging capabilities. Reports indicate TSMC's plans to adopt Panel Level Fan-Out (PLFO) packaging, promising output capacities several times higher than current advanced packaging technologies.

SAMSUNG

Tech Industry

Samsung accelerates race against Intel in glass chip packaging development — glass substrates boost performance

News By Anton Shilov published May 8, 2024

Mass production reportedly starts in 2026.

[Samsung accelerates race against Intel in glass chip packaging development — glass substrates boost performance | Tom's Hardware (tomshardware.com)]

Tech Industry > Manufacturing

Intel's Glass Substrates Advancements Could Revolutionize Multi-Chiplet Packages

News By Anton Shilov published September 18, 2023

Intel reaffirms plans to use glass substrates for multi-chiplet packages, later this decade.

"As Moore's Law has been progressing, traditional scaling has been slowing down," says Ann Kelleher, executive vice president and general manager of Intel's Technology Development. "But as we start doing advanced packaging and heterogeneous integration, it means we can pack a lot more components into a given package and a given product."

[Intel Leads the Way with Advanced Packaging]

TSMC said to adopt larger glass substrates for FOPLP

Rebecca Kuo, Tainan; Rodney Chan, DIGITIMES Asia | Wednesday 24 July 2024 | 0

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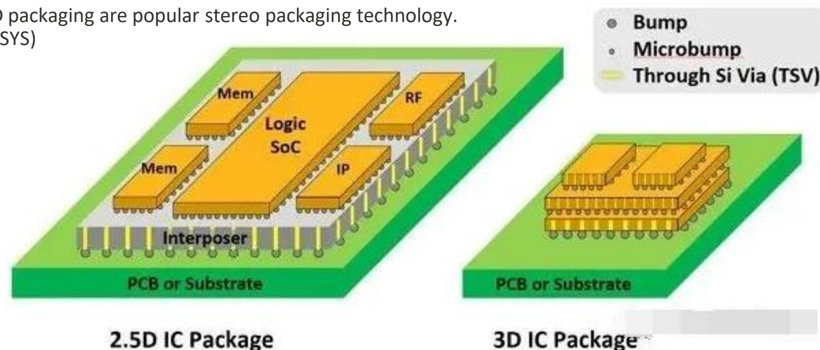
ADVANCED PACKAGING: HETEROGENIOUS INTEGRATION AND GLASS

SEVERAL MONOLITHIC CHIPS ARE PACKED INTO ONE

- More performance (computing power of chip is combined with new components for high communication speeds)
- lower consumption
- reduced costs (less large/expensive silicon elements)
- Supply chain becomes more resilient (combination of different chip manufacturers and their strengths)

2.5D and 3D packaging are popular stereo packaging technology.
(Source: ANSYS)



BENEFITS OF GLASS SUBSTRATES AND INTERPOSERS:

- Superior mechanical, physical, and optical properties
- Enables larger sizes and complex shapes
- Better scaling and higher yields
- Lower power usage

CHALLENGES OF GLASS:

- Brittle and difficult to handle
- Requires new equipment and process investments
- Integration with existing manufacturing methods requires defect free glass processing

ADVANCED PACKAGING: GLASS CORE INTERPOSER AND SUBSTRATE

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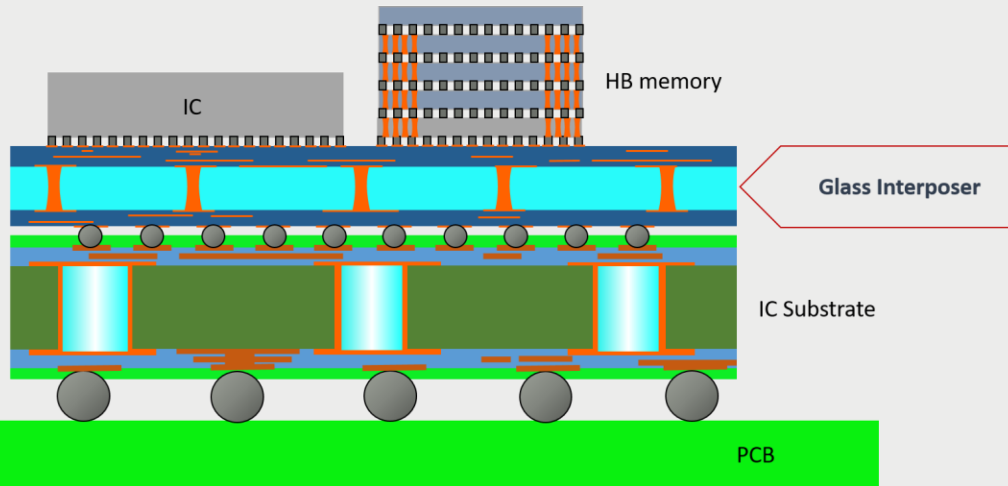
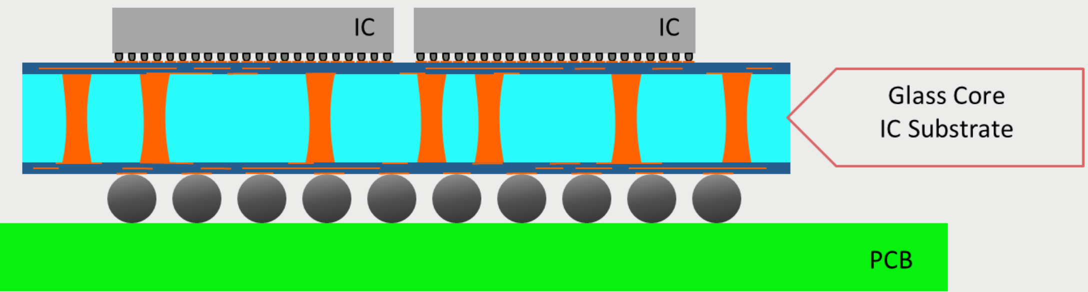
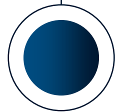
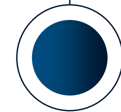






- Glass CTE≈3
- Typical thickness: 400 µm
- Goal: replace costly large area silicon interposer
- Trend towards smaller diameter, thinner substrates
- Highest demand on reliability, cleanliness and process reliability
- Enables scaling to larger packages



- Glass CTE≈7
- Typical thickness: 800 µm
- Core layer must feature higher via densities than organic core to make an additional interposer obsolete
- Enables scaling to larger packages

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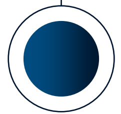
BENEFITS OF THE LIDE-PROCESS

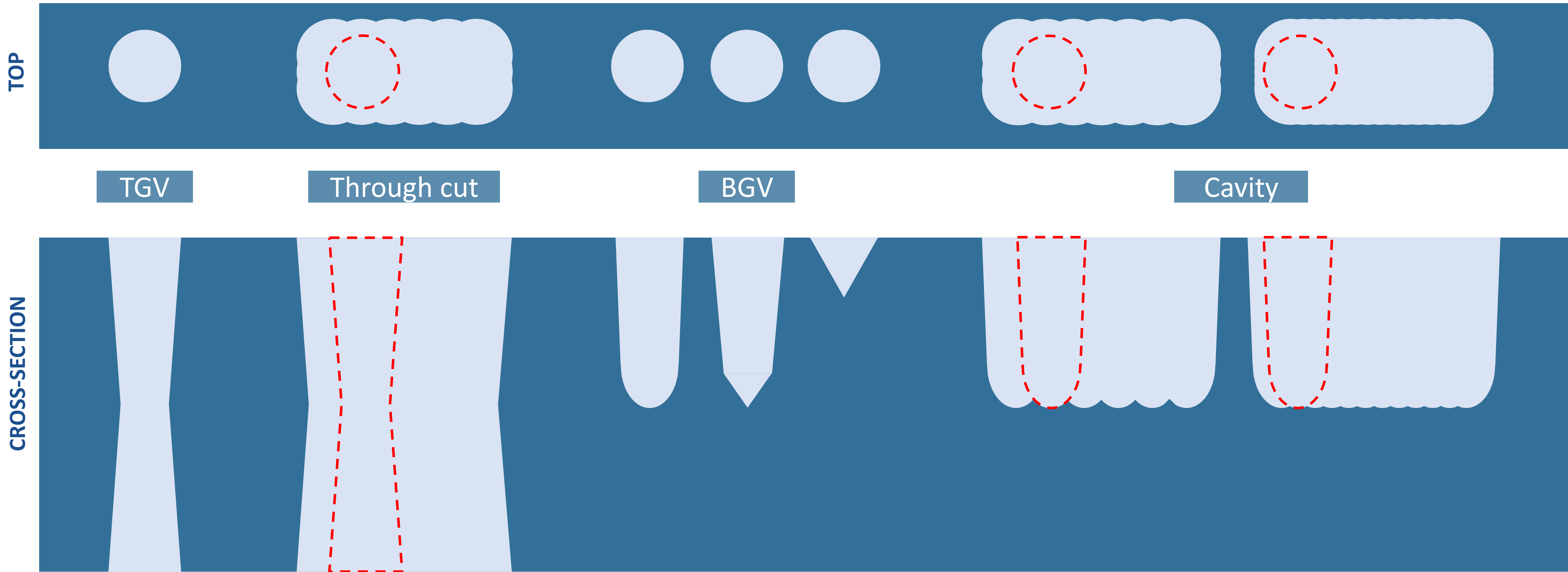
Laser & Electronics



- **Precision and Quality:** Creates high-quality microstructures with high aspect ratios (1:10 to 1:50) in glass without defects.
- **Speed and Efficiency**: Fast and suitable for high-volume production.
- **Cost-Effectiveness:** Reduces production costs with high precision and rapid processing.
- **Versatility**: Processes various glass thicknesses (from 100µm to 1.1mm) for multiple applications.
- **Industry leading quality**: Preserves glass properties by avoiding any defects in the glass.
- **More then TGVs**: Creates TGVs as well as open and closed cavity structures and free combination of all.
- **High Yield:** Improves yield rates, reducing waste and increasing efficiency.
- **Mature technology**: LIDE has a proven track record in serial production.

"LIDE enables economic volume production of high aspect ratio micro features in glass with unprecedented quality and precision."

ADVANTAGES OF LIDE – „MORE THAN TGV“



Parameters

- Diameter

- Surface geometry
- Surface dimensions

- Diameter
- Depth
- Taper angle
- Bottom geometry

- Surface geometry
- Surface dimensions
- Depth
- Bottom geometry

LIDE PROCESS FULFILLS ALL TECHNICAL REQUIREMENTS

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LIDE	Laser + Wet Etch	Lithography + Dry Etch	Laser only	Photo Sensitive Glass	Hot Pressing	Mechanical Drilling
Glass	Glass	Glass	Glass	Glass	Glass	Glass
Laser modification	Laser	Mask Lithography	Electrical Discharge	Mask & Expose UV	Hot Pressung	Mechanical Drilling
Wet Etch	Wet Etch	Dry Etch (RIE)	CO_2 Laser	Bake (Form Ceramic)	Etching	Etching (Optional)
Wash	Wash	Strip & Wash	Wash	Etch & Wash	Wash	Wash

No Thermal Stress						
No Defects						
All-In-One TGV, Cavity, Cutting						
HVM capability						
All Glass Types						

Technologically LIDE is the superior process to generate microstructures in glass and provides the scalability necessary for HVM.

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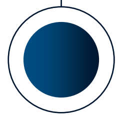
COMPETITION



LIDE IP: Protected by several patents in all markets

Glass Manufacturers:
Companies like Schott, Corning, AGC and NEG actively develop and offer glass for semiconductor applications, but don't offer processing equipment.

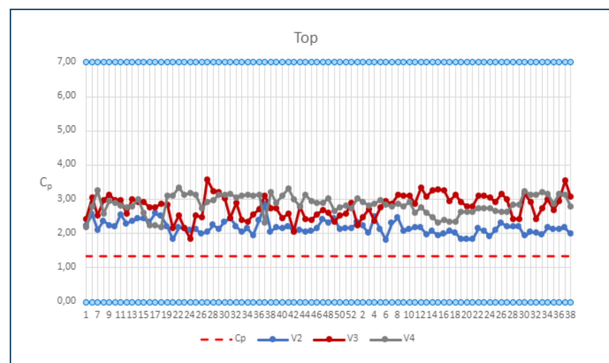
Mechanical Engineering Companies: Companies with laser expertise (e.g., Han's Laser China, E&R Taiwan, Philoptics Korea) have developed laser processes.

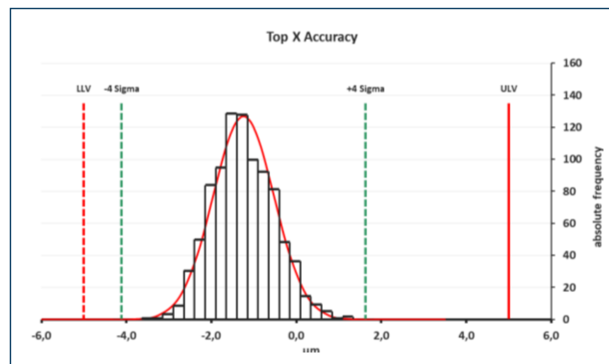
- **Laser Process Issues:** This process is less advanced than LIDE, causing cracks and instability.
- Still in **development phase**, no track record, no experience in volume production.

LPKF LIDE PROCESS EQUIPMENT: STABILITY BY MATURITY

LPKF
Laser & Electronics

- Long term stability of process and equipment data available
- LPKF operates equipment since 2019 in Vitrion fab
- Double digit number of installed tools at customers worldwide
- SEMI compatibility (S2, S8)
- Cleanroom compatibility





Unmatched maturity of LIDE process and process equipment proven by statistics.

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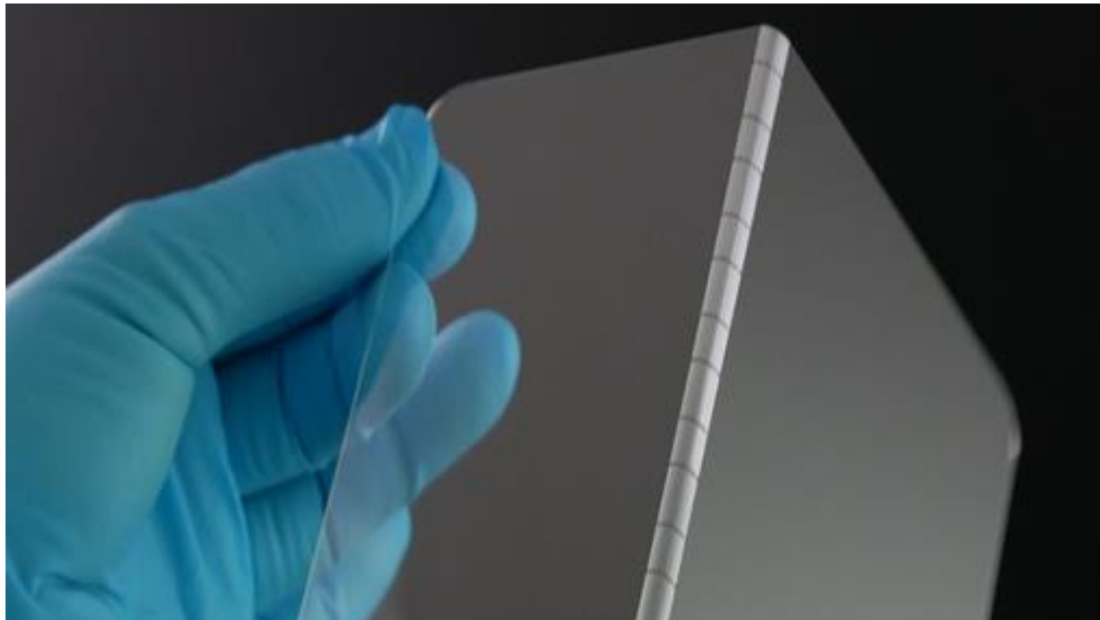
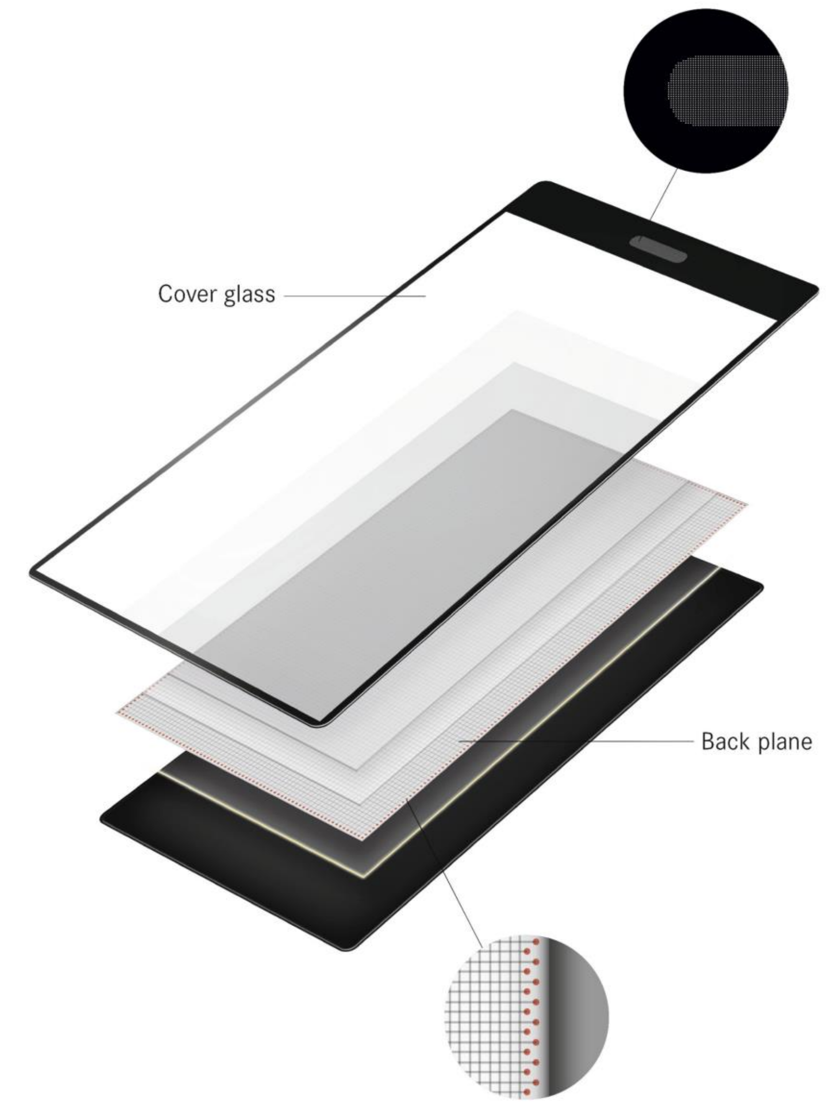
FOLDABLE DISPLAYS: BACKPLANE

LPKF Laser & Electronics





- LIDE equipment in operation for production of display backplanes
- JDA with major mobile display manufacturer

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CORE BUSINESS

GROUP SEGMENT: ELECTRONICS

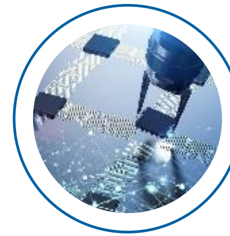
LOCATION

GARBSEN
GERMANY

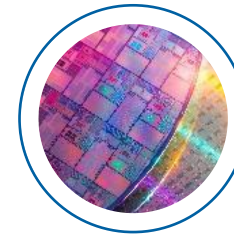
EMPLOYEES

153
WORLDWIDE

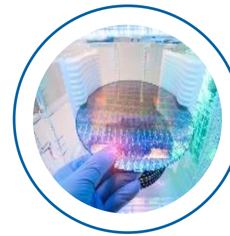
MAIN MARKETS



SMT



ADVANCED PACKAGING



SEMICONDUCTOR

DISPLAY

MARKET OFFERING

SMT TECHNOLOGY, DEPANNELING & MICRO PRECISION PARTS

LASER INDUCED DEEP ETCHING (LIDE)

SERVICE & CONTACT MANUFACTURING

vitrion

LASER DEPANELING REPLACES MECHANICAL SOLUTIONS

Laser & Electronics

MECHANICAL METHODS

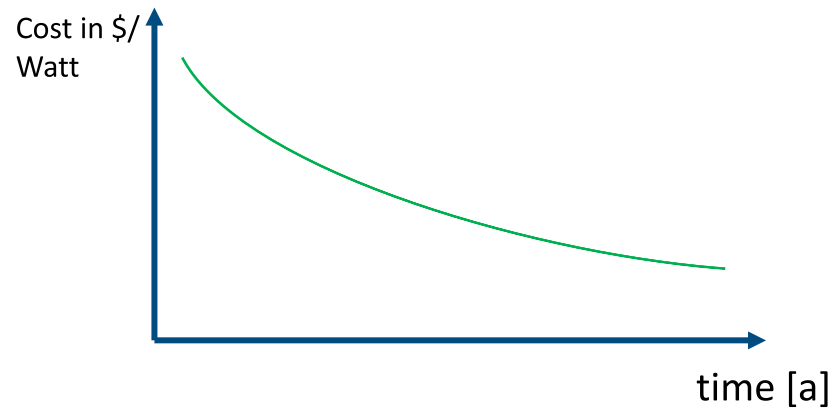
Mechanical Milling

Pizza Cutter

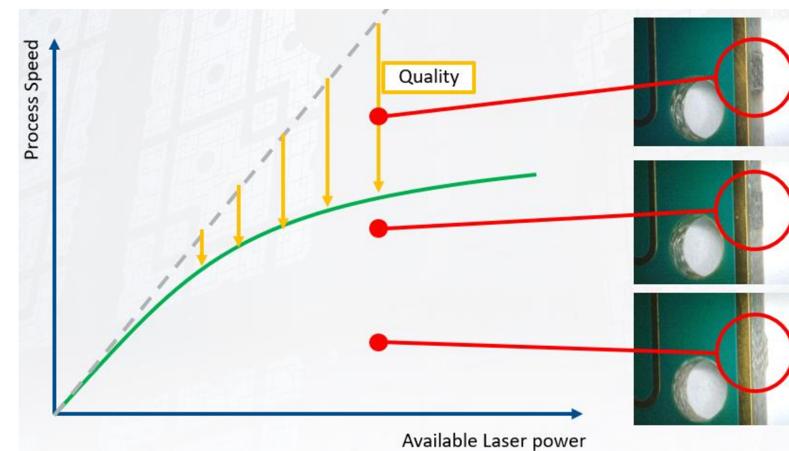
Die Punching

LASER DEPANELING

COST PER LASERPOWER

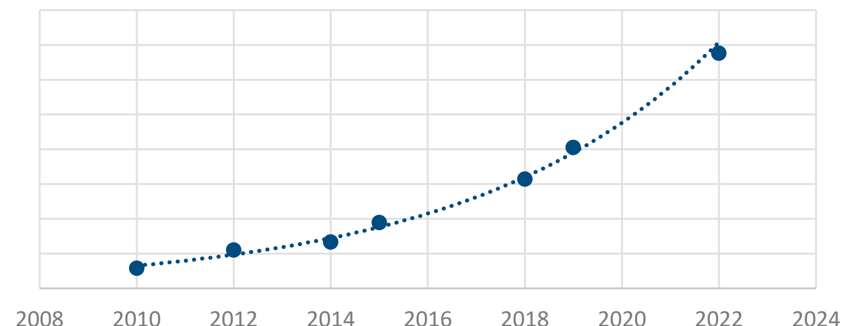


PROBLEMS IN LASER DEPANELING

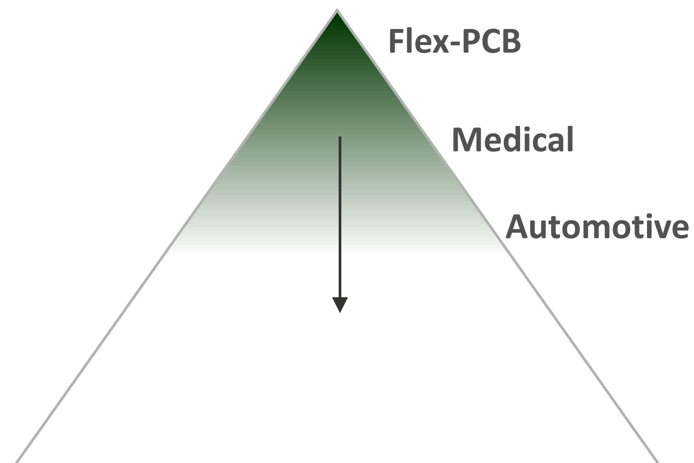


DEPANELING GAINS MARKET SHARE

LPKF'S SOLUTION TO THE LASER POWER DILEMMA



High value/ low quantities



- Approach: keeping quality at higher laser powers by high-speed beam deflection

LPKF Tensor

- Supplementary component of our beam delivery system
- Purpose: efficient and clean application of all of the available laser power
- Patented technology based on LPKF LIDE technology
- Up to 70% faster than competitors in the same performance class

GROUP SEGMENT: DEVELOPMENT

LOCATION

GARBSEN
GERMANY

NAKLO
SLOVENIA

EMPLOYEES

147
WORLDWIDE

MAIN MARKETS

ELECTRONICS

RF & MICROWAVE

MEDICAL

LIFE SCIENCE

MARKET OFFERING

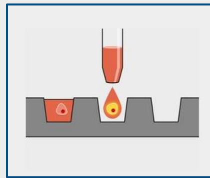
EQUIPMENT FOR RAPID PROTOTYPING OF CIRCUIT BOARDS

SOLUTIONS FOR SINGLE CELL ANALYSIS

WHAT IS ARRALYZE?

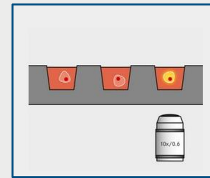
LPKF Laser & Electronics

What we have …



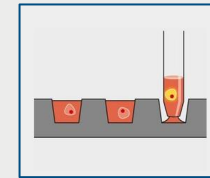
Dispensing Single Cells

- Single cell experiments
- High well density
- Small volume
- Customizable arrays



Live Cell Imaging

- 3 fluorescent channels
- Brightfield
- Phase contrast
- Functional assays
- Prove monoclonality



Cell Extraction

Isolate leads alive

… is a Digital Cell Biology Platform for Discovery, Development and Delivering of Cell-Based Products.

APPLICATIONS

- **Cell Therapy**
- **Monoclonal Antibodies**
- **Cell Line Development**
- **Synthetic Biology**
- **more to come …**

… enables to screen huge cell populations, identify the cells of interest and isolate them.

CUSTOMERS

Academics

Biotech Companies

Pharmaceutical Companies

GROUP SEGMENT: SOLAR

LOCATION

SUHL
GERMANY

EMPLOYEES

130
WORLDWIDE

MAIN MARKETS

THIN FILM SOLAR

TRANSPORTATION & FLAT GLASS

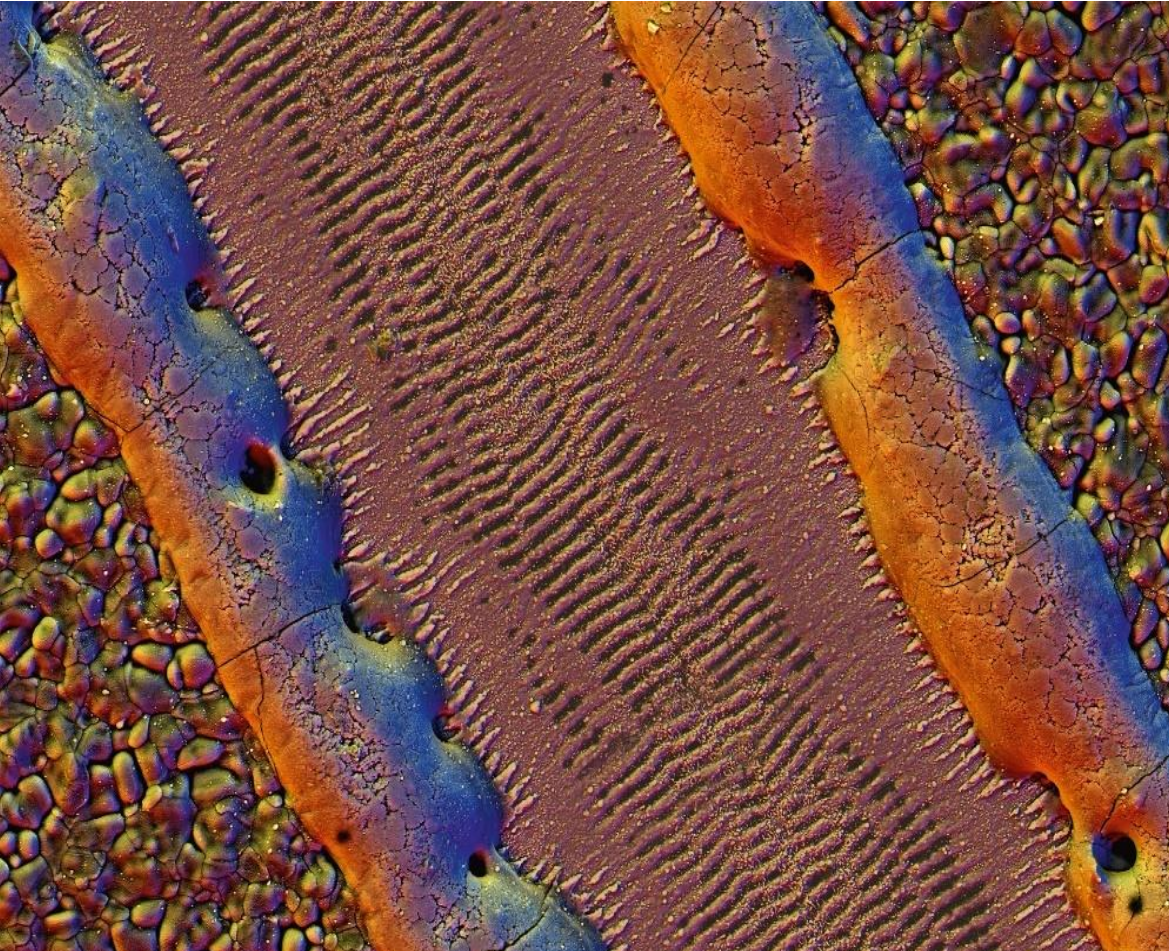
ARCHITECTURE

MARKET OFFERING

LASER PROCESSING OF THIN-FILM MODULES

LASER TRANSFER PRINTING (LTP)

LASER SCRIBING TECHNOLOGY



Laser scribe on a thin-film solar module

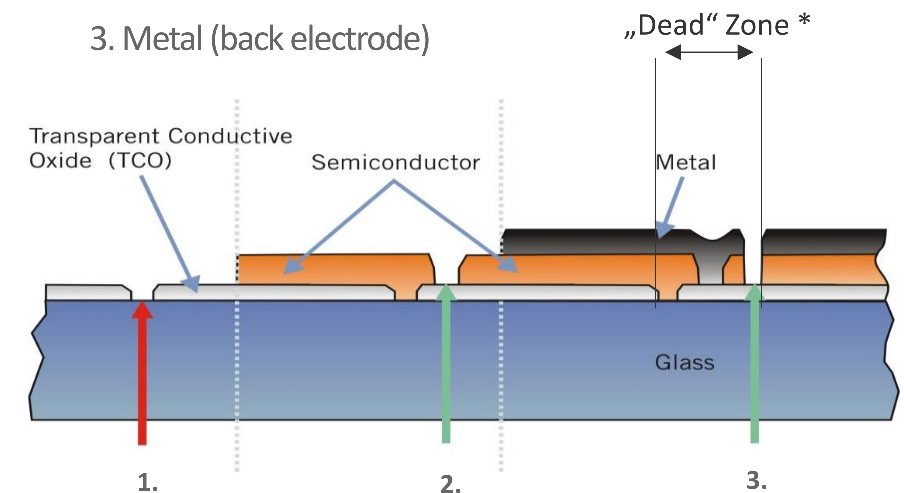
LASER SCRIBING

- Structuring of thin-film solar cells
- Our laser systems provide a competitive advantage by making thin-film solar modules more efficient
- Laser ablation

1. Transparent conductor (front electrode)

2. Semiconductor (CdTe, CIGS)

3. Metal (back electrode)



STRONG DEVELOPMENT OF THIN-FILM TECHNOLOGIES

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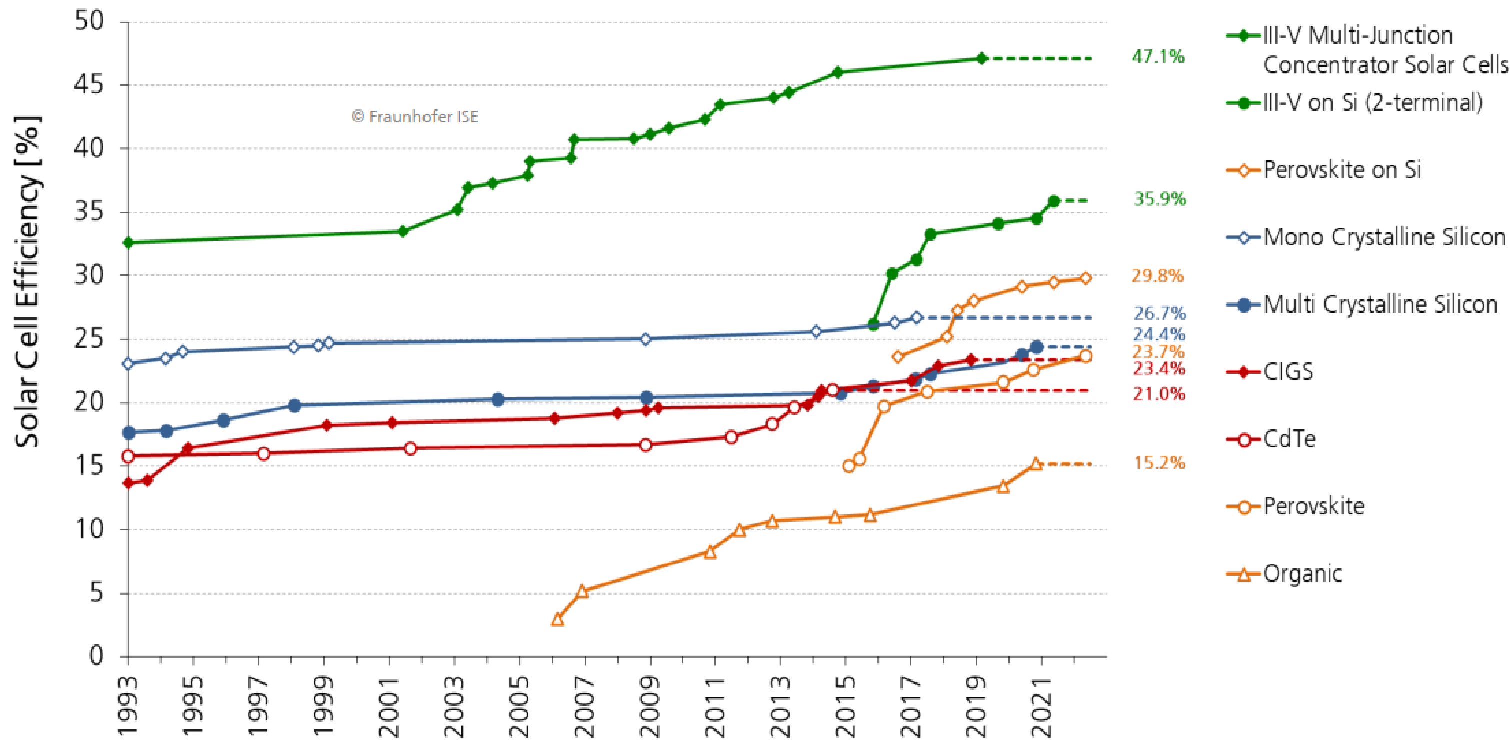

Data: Solar Cell Efficiency Tables (Versions 1 to 60), Progress in Photovoltaics: Research and Applications, 1993-2022.
Graph: Fraunhofer ISE 2022. Date of data: May 2022

- The record lab cell efficiency* is 26.7% for mono-crystalline and 24.4% for multi-crystalline silicon wafer-based technology.
- The highest lab efficiency in thin film technology is 23.4% for CIGS and 21.0% for CdTe solar cells. Record lab cell efficiency for Perovskite is 23.7%.
- Additional opportunities due to Perovskite semiconductor materials entering the thin film market. Lifecycle problems of Perovskite are mainly solved.
- **Perovskite technology offers higher potential efficiencies at lower cost** giving the potential of an increased share of thin film at the total solar market
- **CdTe is strong, Pervoskite market is moving forward**
- **next technology step is multilayer solar modules**

* Only official lab record efficiencies with minimum cell area of 1 cm2 are listed. Latest reference: Solar Cell Efficiency Tables (Version 60), Progress in Photovoltaics: Research and Applications, May 2022

GROUP SEGMENT: WELDING

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LOCATION

FÜRTH
GERMANY

EMPLOYEES

147
WORLDWIDE

MAIN MARKETS

AUTOMOTIVE

MEDICAL

CONSUMER

OTHERS

MARKET OFFERING

APPLICATION CENTER & CONSULTING

SERVICE & CONTACT MANUFACTURING

MACHINE AND TOOLS

Laser & Electronics

LPKF Laser & Technology SE

Q&A SESSION

LPKF
Laser & Electronics

THANK YOU FOR YOUR ATTENTION

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