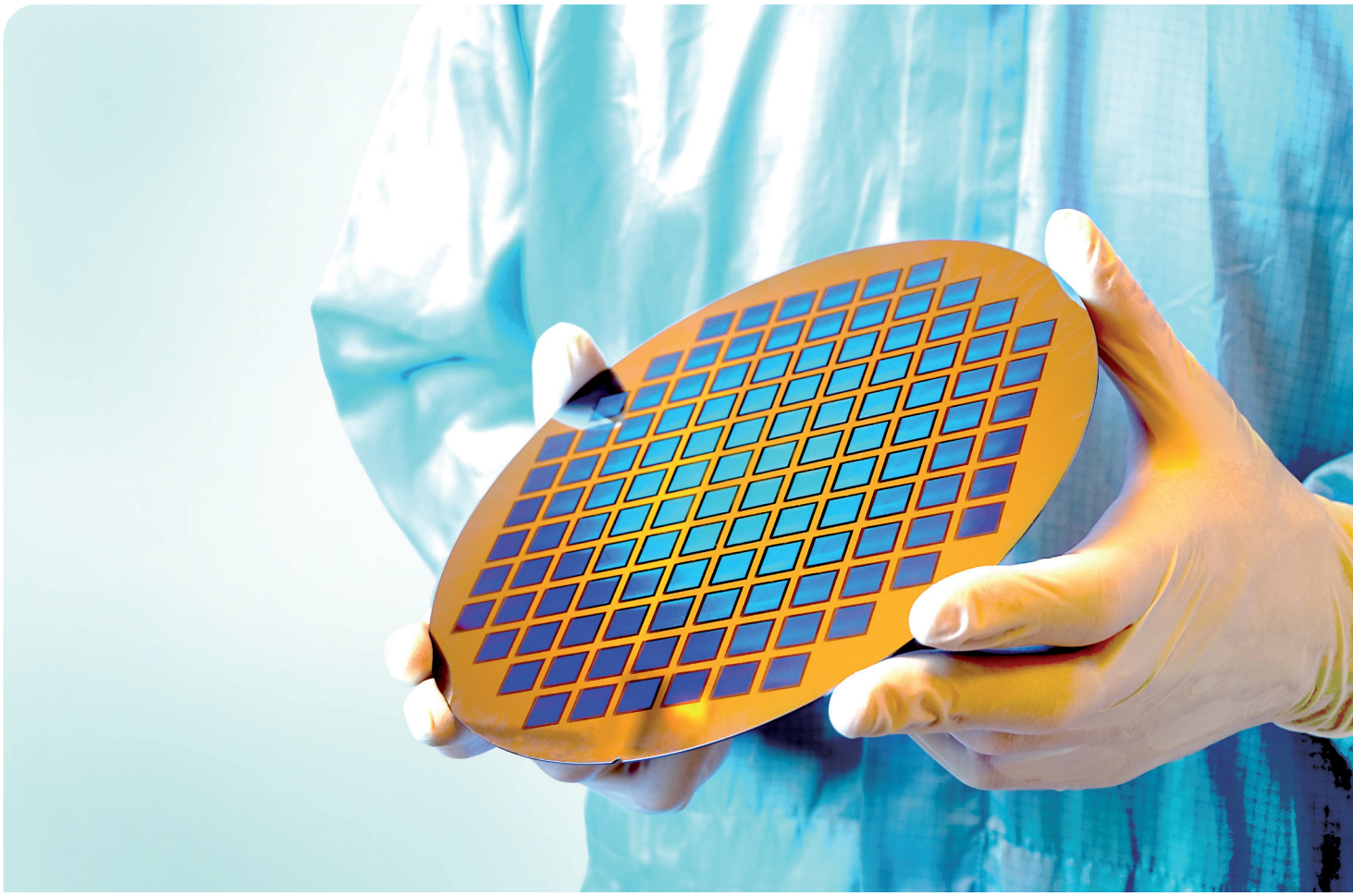
PROFACTOR®
FROM RESEARCH TO PRODUCTION

Nanoimprint Lithography

Advanced Solutions for the Replication of Micro- and Nanostructures



Nanoimprint Lithography (NIL)

A versatile and cost-effective technology for the replication of micro- and nanostructures

Nanoimprint Lithography is a mature technology that uses stamping to replicate micro- or nano patterns onto a wide range of substrates such as wafers, glass, ceramics, plastics or metals.

Markets are demanding more and more functionalized surfaces, especially in the application area of micro-optics and life sciences.

PROFACTOR has extensive experience in micro- and nanoimprinting process technology and has even developed R&D tools for automated replication.

Since 2004 our NIL experts have helped customers to create specific NIL prototypes and small series demonstrators using a full spectrum of processes, from manual manufacturing to semi-automated production.

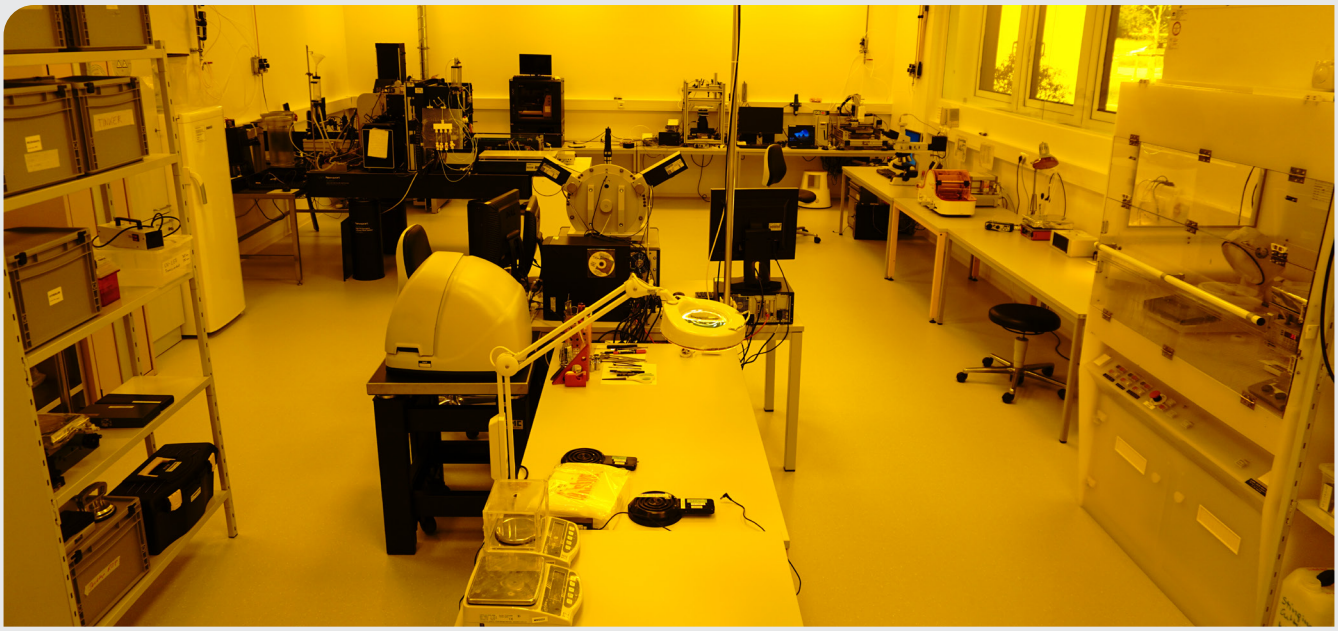
Advantages

Overall, NIL technology is versatile and offers important advantages such as

- **Scalability:** The same process can be used to manufacture a few to 100 parts but can also be scaled to mass fabrication of up to 1 million parts.
- **High replication quality:** NIL processes are capable of replicating structures with very smooth surfaces and sharp edges.
- **Wide range of feature sizes:** The versatility of NIL is also demonstrated by the wide range of feature sizes to be produced, which span from a few nanometers up to several hundred micrometers.

PROFACTOR covers the whole spectrum from **NIL research** and **prototyping** to **small series manufacturing.**

We are happy to imprint for you.



PROFACTOR cleanroom

Prototyping Micro- and Nanostructures

The fast way from your idea to a functional demonstrator

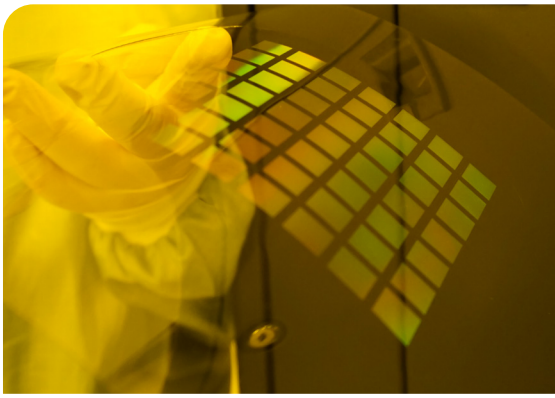
Nanoimprinting can be a game changer for novel product ideas or innovative functionality.

At PROFACTOR we have helped many customers to prototype their innovative ideas, starting with single prototype devices if needed. Hence, they could **show and test** their innovation, rather than only talking about it.

Our **research-driven approach, expertise and process portfolio** are also well-suited for working with non-conventional designs or materials.

Prototyping it is not only about **gaining insights into new products** but also about **process technologies** for future series production.

We help you to make your idea visible with a functional demonstrator.



Nanostructures on a flexible substrate

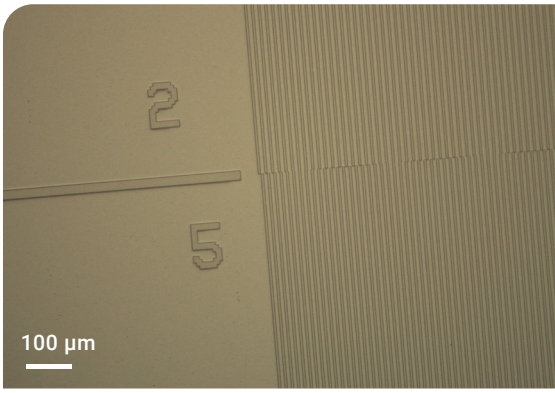
Features

- Structure heights from 15nm to 750µm
- Aspect ratios of up to 25
- Undercut features

Nanostructures on free-form surfaces

Materials & substrates

- UV-curable polymers
- UV-curable ceramic materials
- High refractive index materials
- Flat surfaces of any material (up to 250x500mm)
- Free-form (curved) surfaces
- Free-standing films



Microstructured ceramic material

Process portfolio

- Classic UV-NIL, Reversal NIL, Full wafer imprinting
- 3D NIL
- Step&Repeat NIL (micro/nano), Roll-to-Plate NIL with STENSBORG technology, large area NIL

Small Series Nanoimprinting

For small-volume production of micro/nano structures. The step before NIL mass production.

NIL is a truly versatile technology that **can be scaled from manufacturing a few prototypes up to series production** involving an increasing degree of process automation.

Building on prototypes and first demonstrators, at PROFACTOR we can also deliver micro/nano structures in small volume, e.g. from hundreds to a few thousand devices depending on your needs.

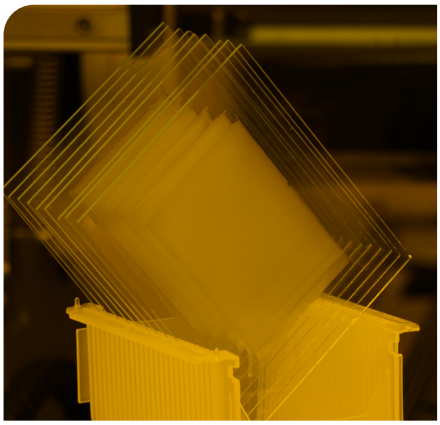
With small series nanoimprinting we can supply quantities that are too high for manual manufacturing but are still too low for expensive and fully automated volume production.

Benefits

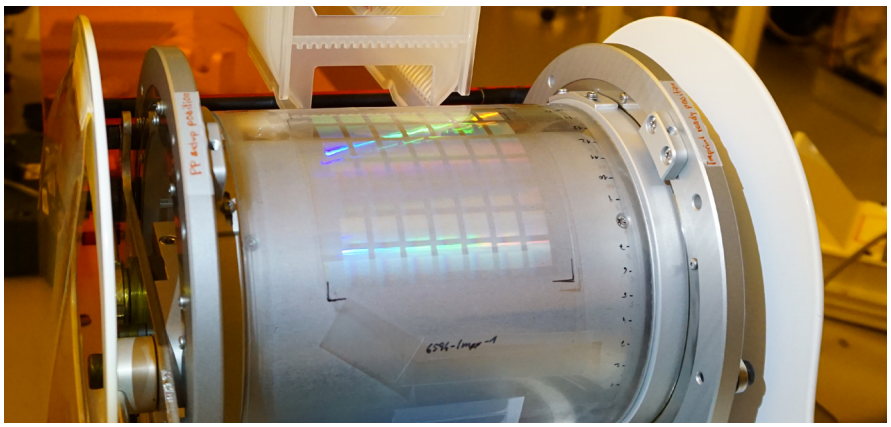
- **Real-life testing:** For product qualification or field trials, typically a limited number of identical devices is required. Small series manufacturing is a cost-effective way to provide such a small volume.
- **Data for process upscaling:** Small series production gives reliable insights and process data (cycle time, lifetime of stamps, material consumption, yield) for further upscaling towards high volume production.
- **Ready for application:** Small series devices can also be used as final products in your application.
- **Ready for process transfer:** Small series imprinting is the right step before transferring the process to your manufacturing facility or any other fab/subcontractor to start high volume production.

Selected applications

- **Micro-optics:** Structure fidelity and edge sharpness is a clear advantage of NIL over other replication technologies.
- **Nano-optics:** With NIL, structures can be replicated down to feature sizes of less than 10nm.
- **Microfluidic devices:** Nanoimprinting is especially suited for fast and cost-effective manufacturing of low numbers of tailored microfluidic devices.



Lenticular lenses replicated with STENSBORG Roll-to-Plate NIL



Nanostructures replicated with Step&Repeat and STENSBORG Roll-to-Plate NIL

Step&Repeat Technology

Processes and tools for the semi-automated replication of micro- and nanostructures

Step&Repeat Nanoimprinting (S&R NIL) is a semi-automated process for the fast and cost-effective replication of a small-sized die.

This process is very flexible and can be used for a wide range of feature sizes, from some nanometers up to a few hundred micrometers.

Material testing and template manufacturing services

With the Step&Repeat process we can support your development through

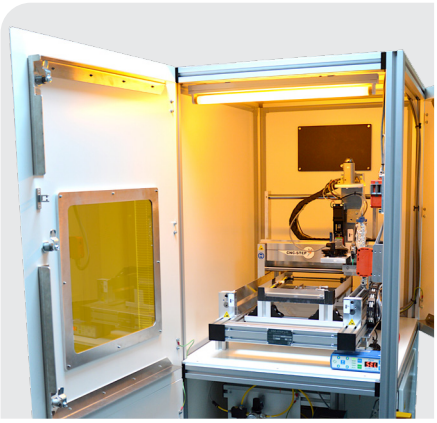
- **automated testing of new materials** including characterization,
- **manufacturing of multi-structured templates** for mass fabrication technologies such as injection molding, Roll-to-Plate NIL or Roll-to-Roll NIL,
- **small-series production** of micro- or nanostructured devices or nanoparticles.

Step&Repeat laboratory tools

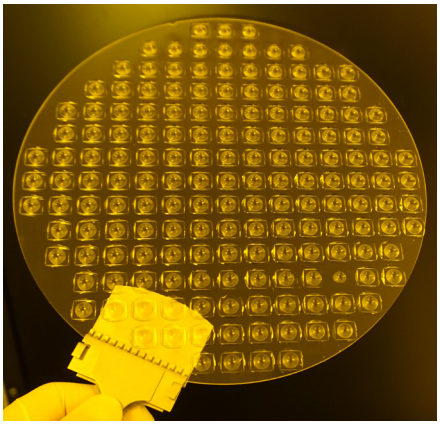
Based on our extensive experience in nanoimprinting research, we have developed specific Step&Repeat tools for laboratory use. These tools are easy to operate and allow direct process observation.

- **Soft-NIL-Stepper** for the replication of nanostructures on a pre-coated substrate
- **Multi-tool** for the replication of microstructures with in-situ resist application

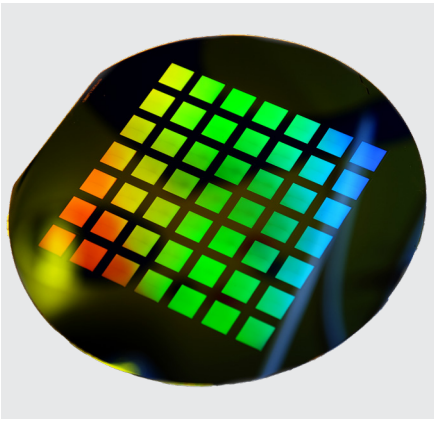
You can learn more about our Step&Repeat tools during a hands-on workshop. Depending on your requirements we can customize the tools for your specific needs.



Step&Repeat tool for microstructures (Multitool)



S&R Sample: Microstructures



S&R Sample: Nanostructures

Other R&D Services and Products

Supporting your development projects through advanced metrology and NIL materials

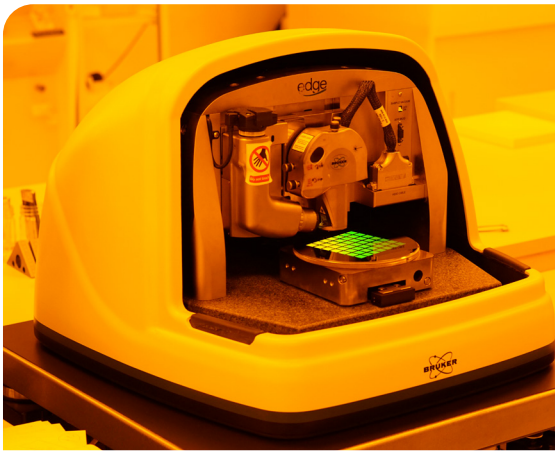
Characterization as a Service

A detailed characterization of materials and micro/nano features is a prerequisite for clear insights and quality control during process development and manufacturing.

PROFACTOR has a wide range of special test and measurement equipment and extensive experience in characterization of typical nanoimprinting parameters.

Equipment and methods

- Atomic Force Microscopy
- Ellipsometry
- Laser Scanning Microscopy
- Profilometry
- Optical Microscopy
- Contact Angle Measurement
- UV/VIS Transmission Spectroscopy



Atomic Force Microscope

NIL Process Liquids

PROFACTOR process liquids have successfully been used in numerous customer projects.

Adhesion Promoter HMNP-12

Available in 100 mL, 250mL or in custom quantity.

Anti-Sticking Layer BGL-GZ-96

This is the successor of our well-known BGL-GZ-83 product.
It is available in 100 mL, 250mL or custom quantity.

Anti-Sticking Layer BGL-GZ-96

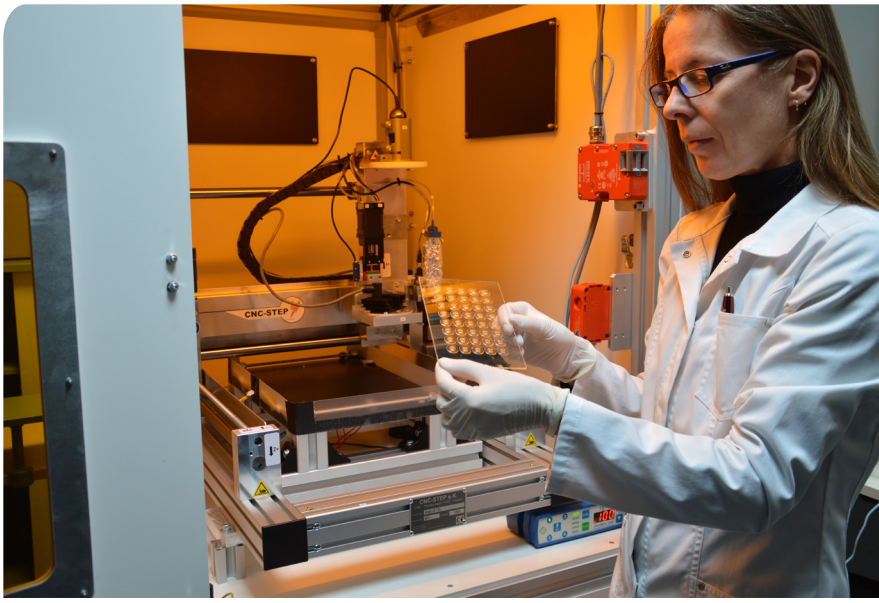
4 Steps from Feasibility to Volume Production

Our approach to flexible and risk-aware process development

Nanoimprinting allows the cost-effective application of micro/nano patterns or functionalization of a wide range of products.

At PROFACTOR we strive to **make your project a success.**

From our experience we've developed a **step-by-step approach** to offer flexibility along the path from feasibility towards the final product while managing the remaining development risks.



Step&Repeat process for semi-automated nanoimprinting.

Step 1: Definition and first imprint tests

- Definition of the application, the desired micro- or nano-structure and the favored materials.
- We will perform first NIL imprint trials and test material/structure combinations.
- This will answer your key feasibility questions.

Step 2: Demonstrators and prototypes

- We will manufacture a demonstrator or a small number of prototypes according to your design using manual NIL processes.
- This will help you to test functionality and quality or get an approval from your customer.

Step 3: Development of automated processes and small series manufacturing

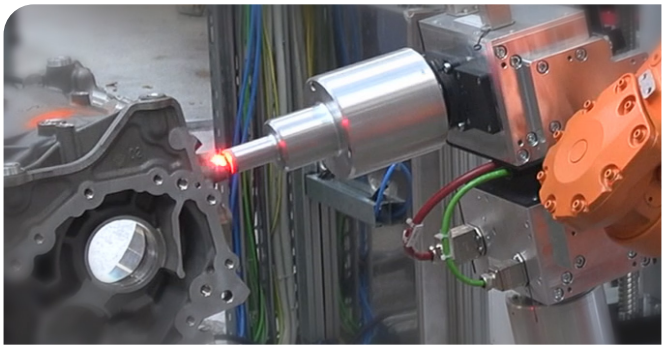
- We will develop processes for Step&Repeat and Roll-to-Plate NIL for semi-automated manufacturing of larger volumes and produce 100 to several 1000 imprints of your designs.
- This allows you to qualify your product design and start the first field tests.

Step 4: Process transfer and ramp up

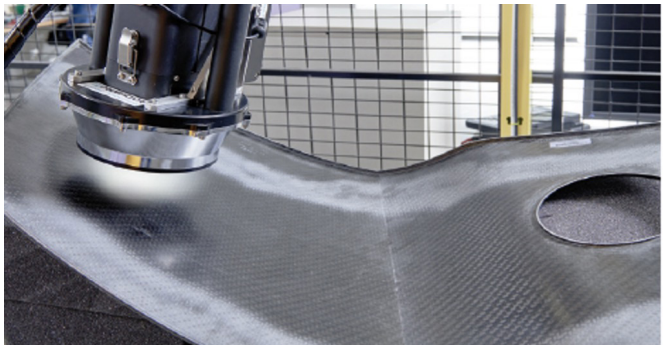
- We will transfer the process to your facility or any other fab/subcontractor and help to ramp it up.
- This will enable you to manufacture your micro- or nanostructures in large quantities.

PROFACTOR – Your Advanced Technology Partner

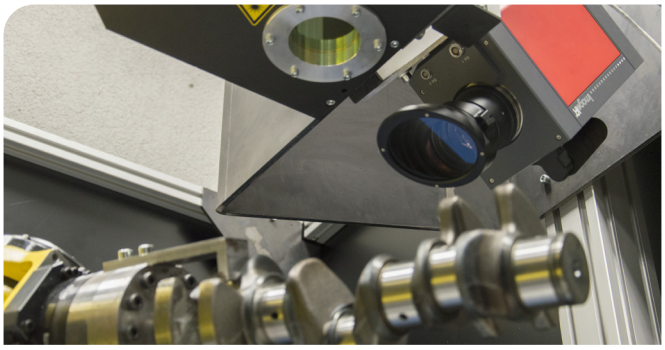
Industrial Inspection – Collaborative Robotics – Digital Assistance – Freeform Inkjet Printing – Printed Electronics



Surface inspection of metal parts with minimal pseudo-error rates

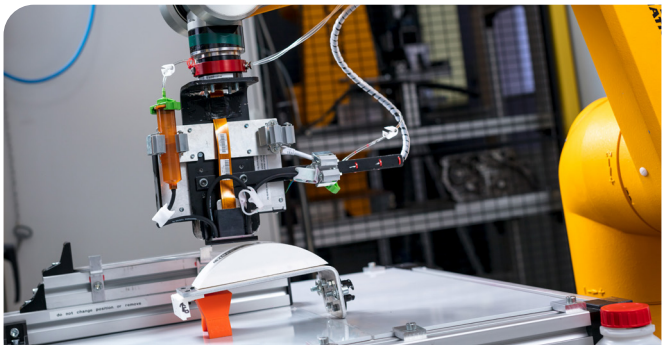


Surface inspection of fiber composite components and materials

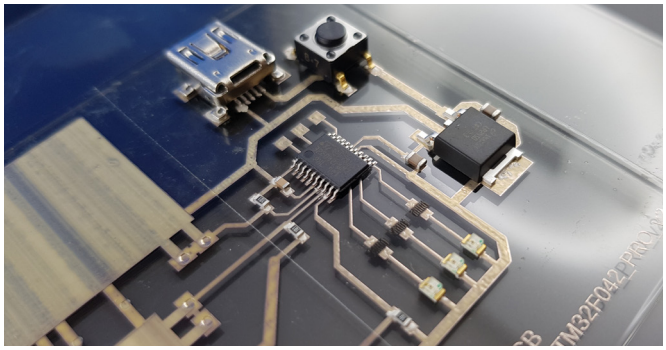


Industrial thermography: automated non-destructive crack detection

Robotic and digital assistance



Freeform inkjet printing systems



Printed electronics

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