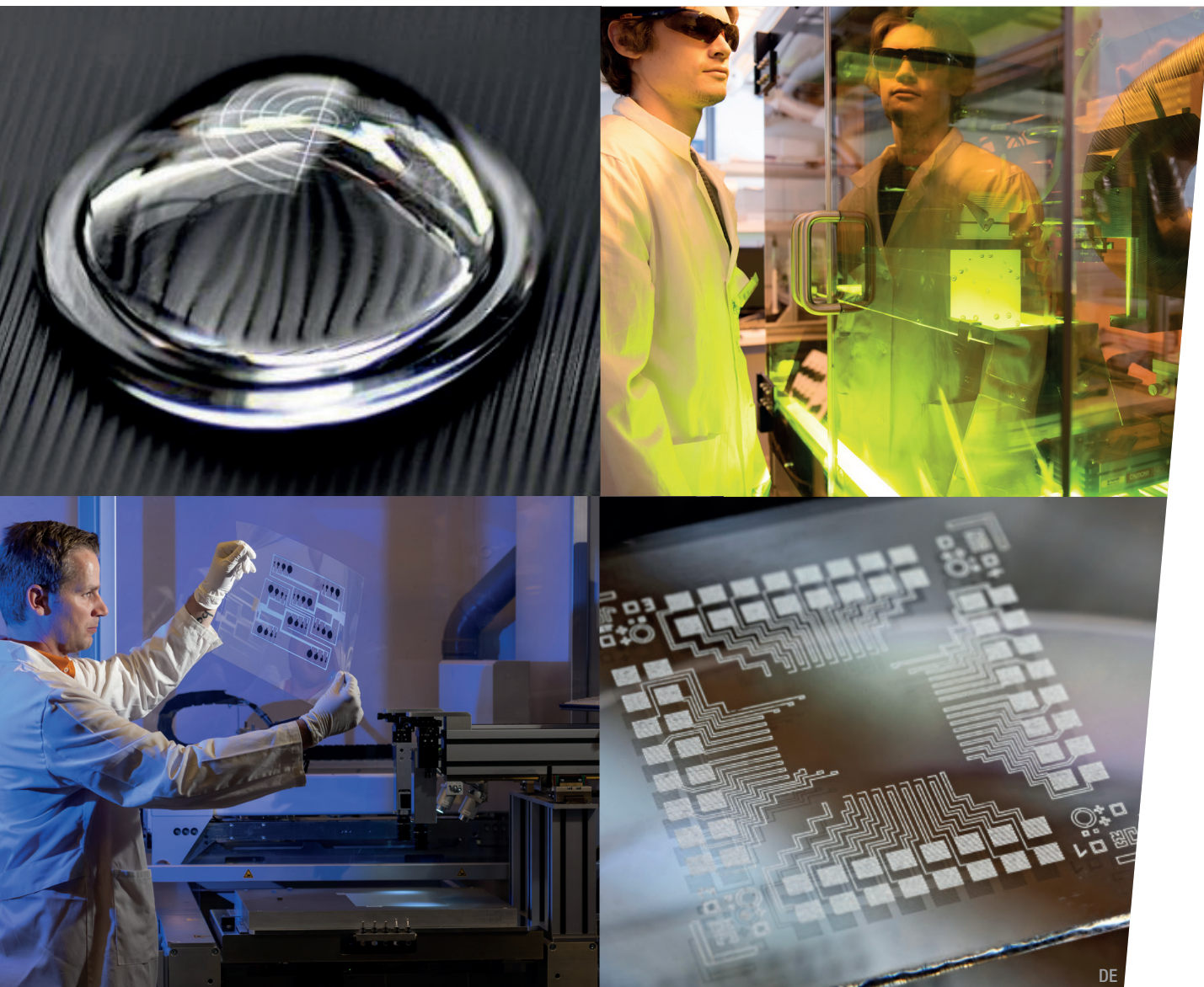


JOANNEUM  
RESEARCH  
MATERIALS



# *Bring life to your surface*

We are your partner in functional printing

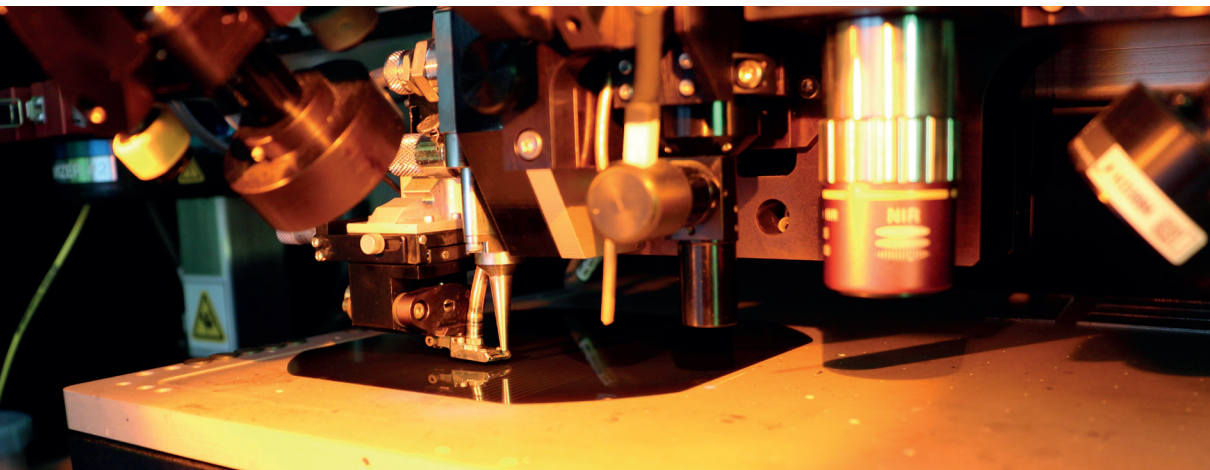


THE INNOVATION COMPANY

## What we offer

For your product or application we are the one-stop-shop for the development of scalable printing processes:

- Proof of concept
  - Prototyping
  - Demonstrator development
  - Upscaling of production
  - Sourcing of material and equipment suppliers as well as contract manufacturers
  - Manufacturing process transfer
  - Small production runs are available as a service
  - Joint development in nationally or internationally funded projects
  - Contract research
- Definition and specification
  - Ink development
  - Substrate pretreatment
  - Print strategy (Aerosoljet, Inkjet, Screen, ...)
  - Post-processing
  - Characterisation
  - Prototype fabrication & small batch production



## Applications and use cases

### Packaging and assembly

- High density interconnects, flex circuits, Direct die Attach, embedded/Integrated passives, replacing wire bonds

### Electronic components

- Resistors, capacitors, inductors, micro-antennae (RFID), micro-batteries

### Electronic devices

- 3D MID, 3D smart structures, displays

### Energy

- Fuel cells, solar cells

### Sensors

- Humidity
- Touch
- Printed circuitry, standard electronic components, 3D printed cover

### Wearables

- Smart textiles

### Security features

- Fluorescent dies, high resolution patterns



## USP

- One stop shop: complete value chain from ink development – surface modification – printing strategy – post processing – characterisation
- Printing on low temperature substrates
- Combination of different printing technologies
- PIXDRO platform can be adapted to a variety of requirements (e.g. implementation of solenoid valve, MicroFab® single nozzles and electrostatic printing)
- Interdisciplinary team of highly skilled experts

## Ink development

**Main functionalities include (but are not limited to):**

- Conductivity (self reducing metallic inks, ionic inks, stretchable inks)
- Isolation (dielectric)
- Sensing (pH, gas, humidity, proximity, piezo)
- Adhesives
- Biological,
- Magnetic,
- Fluorescent features

## Various substrates

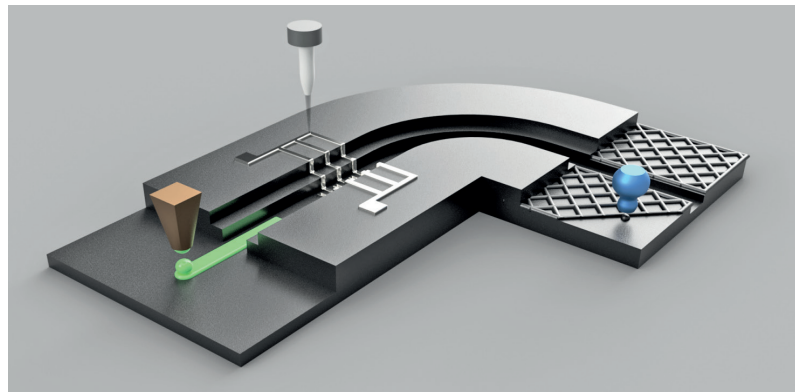
**We print on your substrates e.g.:**

- |  |                     |
|--|---------------------|
| ■ Polymers (e.g. for thermoforming, stretchable) | ■ Metal layers      |
| ■ Glass  | ■ Silicon wafer     |
| ■ Ceramics                                       | ■ Paper             |
| ■ FR4  | ■ 3D substrates     |
|  | ■ customer specific |

## Advantages of functional printing

**Digital printing generally offers following advantages:**

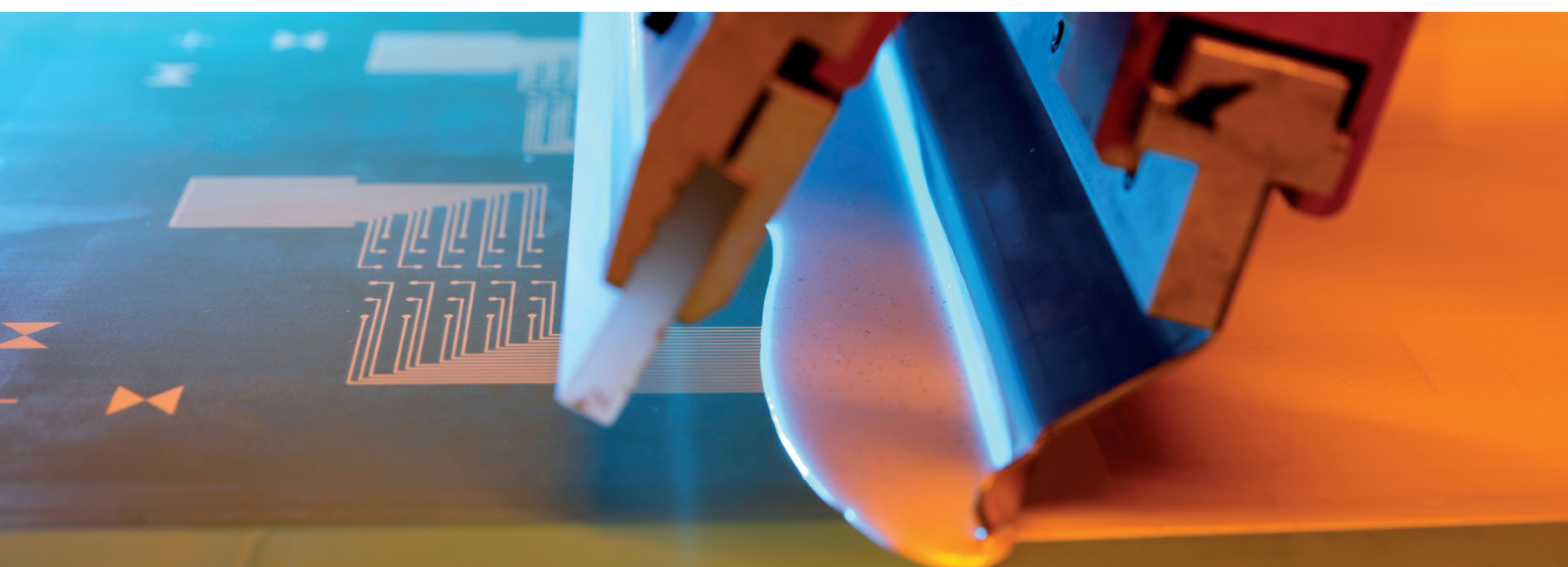
- Enabling new design possibilities
- Flexible and formable
- Contactless printing
- Rapid prototyping
- Reduce system cost, size or weight
- Functionalisation of 2D/3D surfaces
- High resolution printing
- Monolithic integration into components



## Surface modifications

**Various surface modifications of substrates are possible**

- |                            |                            |
|----------------------------|----------------------------|
| ■ Coating (HMDS, DLC, ...) | ■ UV                       |
| ■ Corona treatment         | ■ Ozone                    |
| ■ Plasma activation        | ■ Nano Imprint Lithography |

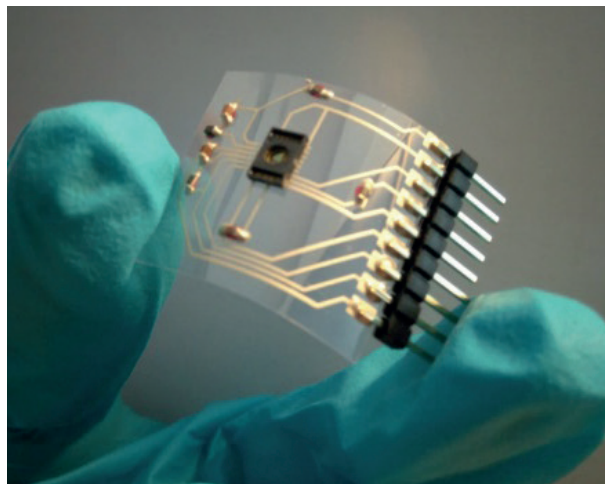


## Printing technologies

### Inkjet printing

Inkjet Printing is a contactless and digital (maskless) industrial scalable printing technology. Thereby single droplets of low viscosity inks are ejected from nozzles located in the printing head. Each droplet ejection is triggered by a voltage driven piezo-element, literally squeezing out each droplet of the corresponding nozzle. Industrial inkjet printing heads

contain up to 2048 nozzles, allowing for a high degree of parallelization and throughput. At the MATERIALS institute three state-of-the-art inkjet printers are available, a Dimatix DMP 2800 and two PIXDRO LP50 (one in the clean room) systems, allowing for the integration of different industrial printing heads.

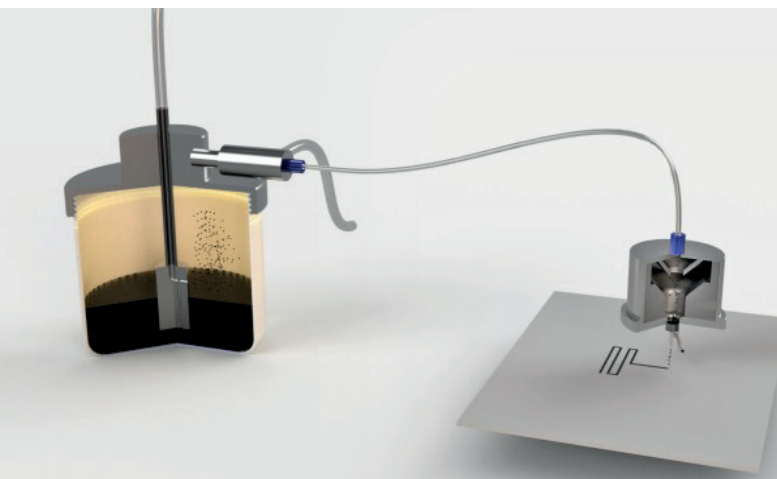


### Aerosoljet printing

Aerosoljet Printing is a contactless direct structuring method featuring high resolution (down to 10µm) with many advantages:

- Low cost: hard-tooling and mask costs are eliminated thereby enabling cost effective manufacturing even in low volume production runs
- Printing on both planar and non planar (3D) substrates

- CAD driven, tool-less processes to speed up product development and manufacturing, while allowing greater flexibility in mass customization
- Potential for revolutionary new end-products with improved performance based on novel size, geometries (including 3D Interconnects), materials and material combinations in a high viscosity range





## Printing technologies

### Screen printing

In the field of printed electronics, screen printing is regarded as a standard, industrial process for device fabrication. It offers a high variation in geometry and design and scalability for the resulting layers and allows for high throughput at low costs.

### Electro-static printing

Electro-static printing represents a novel deposition technique capable of applying functional inks in a viscosity range and droplet volume currently not available for classical piezo based ink jet technologies. Electro Static Printing is still in development.

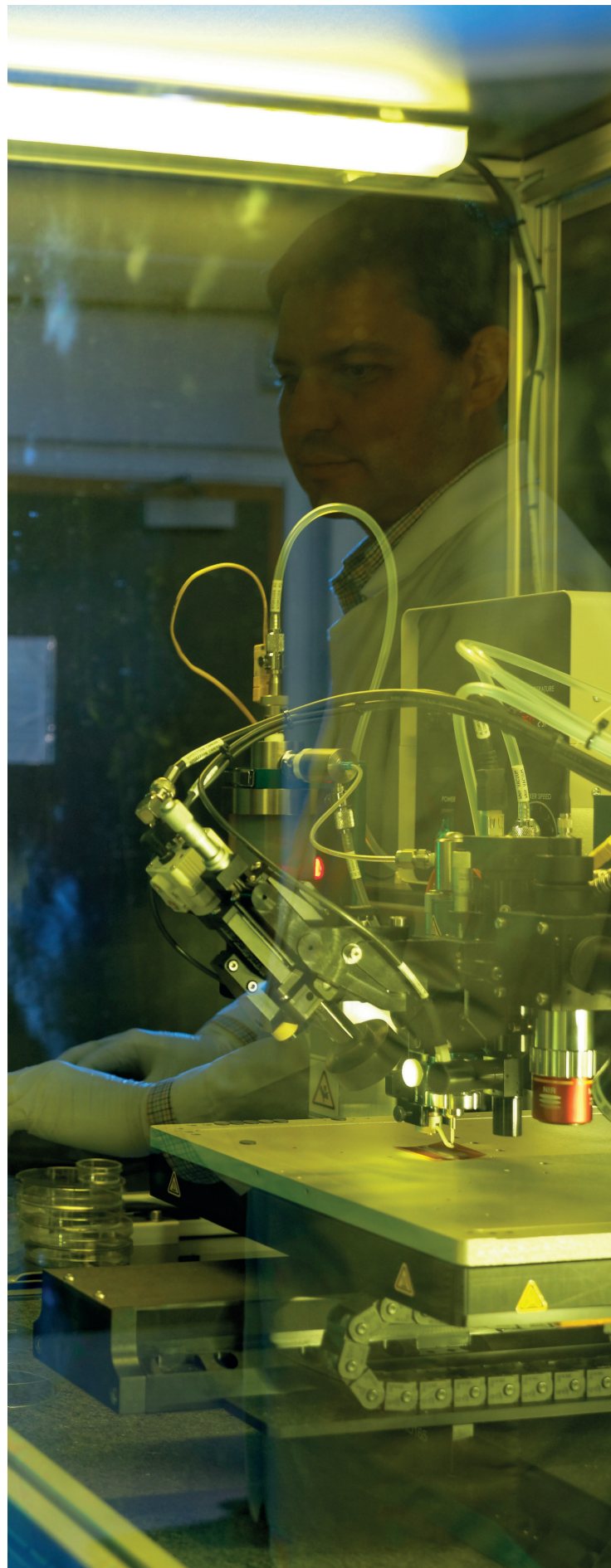
### Microarray spotting

A microarray spotter is an automated device that has multiple piezo dispensing capillaries (PDCs) to process extremely small volumes (i.e. from picoliter to microliter) of solutions of various types. With such a technology, oligonucleotides, proteins, nanoparticles and fluorescent dyes can be bound to a variety of surfaces (e.g. glass, silicon, silicon dioxide, gold, hydrogel and polymers). This enables simple, cost-effective production with high throughput and is particularly suited for producing biochips for diagnostic applications.

## Post processing

For enabling the required functionality post processing of the printed patterns is required e.g.:

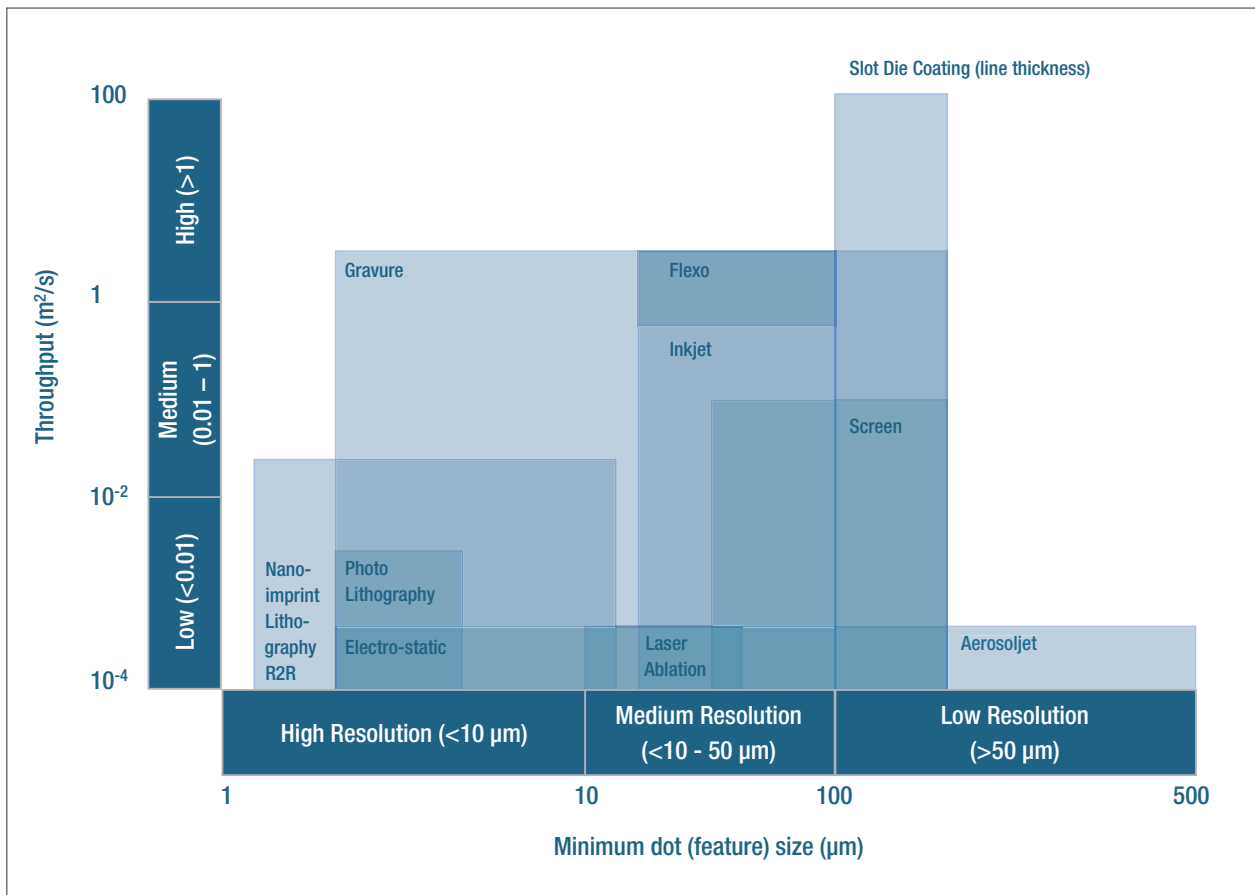
- Thermal curing
- Laser curing
- UV curing



## Key facts

PRINTING CAPABILITIES AT JOANNEUM RESEARCH							
	Analog Printing Techniques		Digital Printing Techniques				
	Screen Printing	Flexography	Inkjet Printing	Solenoid Valve Printing	Aerosoljet Printing	Microarray Spotter	ESJET
Application Technique	Additive						
Amount of Material/ Drop Size	Large amount of ink deposited, excess remains on screen	Large amount of ink, excess remains on cliché and anilox roll	5 – 180 pL	0,25 – 1 mm	Continuous Jet	50-800 pl	0.001 – 300 pL/ Continuous Jet
Printing Template	Print layout modifications require a new screen		Digital printing files (easy adaptable)				
Ink Viscosity	Pastes with several thousand mPas	50 – 10.000 mPas	max. 50 mPas	50 – 1000 mPas	<1000 mPas	1 – 10 mPas	1 - 10.000 mPas
Min. Feature Size	50 µm	50 µm	30 µm	300 µm	10 µm	100 µm	1 µm
Printing Speed/ Frequency	50 – 1000 mm/s	99 m/s	up to 40 kHz	up to 1400 Hz	up to 100 mm/s	up to 100 mm/s	500 mm/s
Printing Area	400 x 400 mm	240 x 75 mm	300 x 210 mm	300 x 210 mm	300 x 300 mm	246 x 300 mm	300 x 210 mm

## Technology clusters printing & patterning



Printing technologies available at JOANNEUM RESEARCH

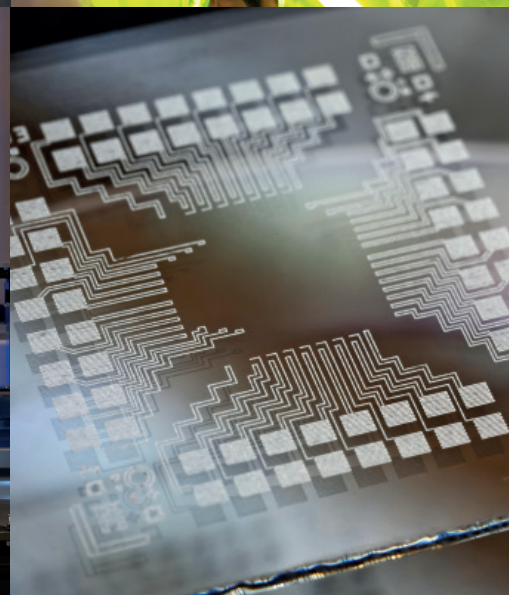
## PIXDRO application lab

We are the application lab for  
SUSS MicroTec Netherlands B.V.





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