



INVEEL

SFA-AM Review Meeting
Barbara Horvath

Printed electronics

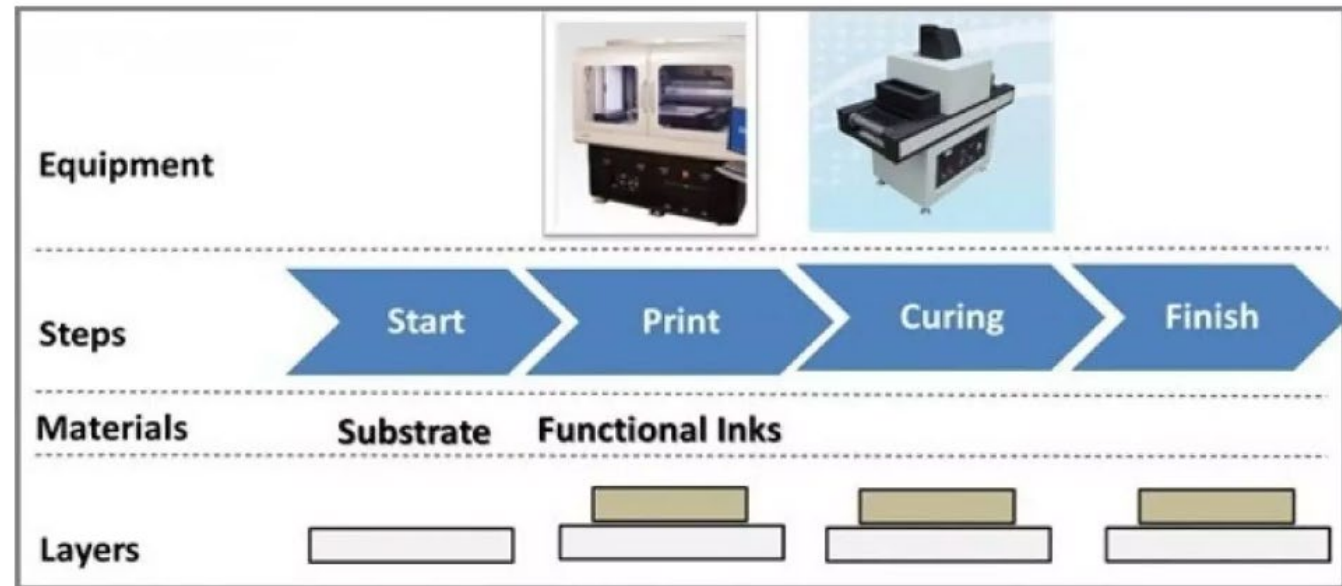


Additive printing methods used to create electrical devices on various substrates



Printing techniques:

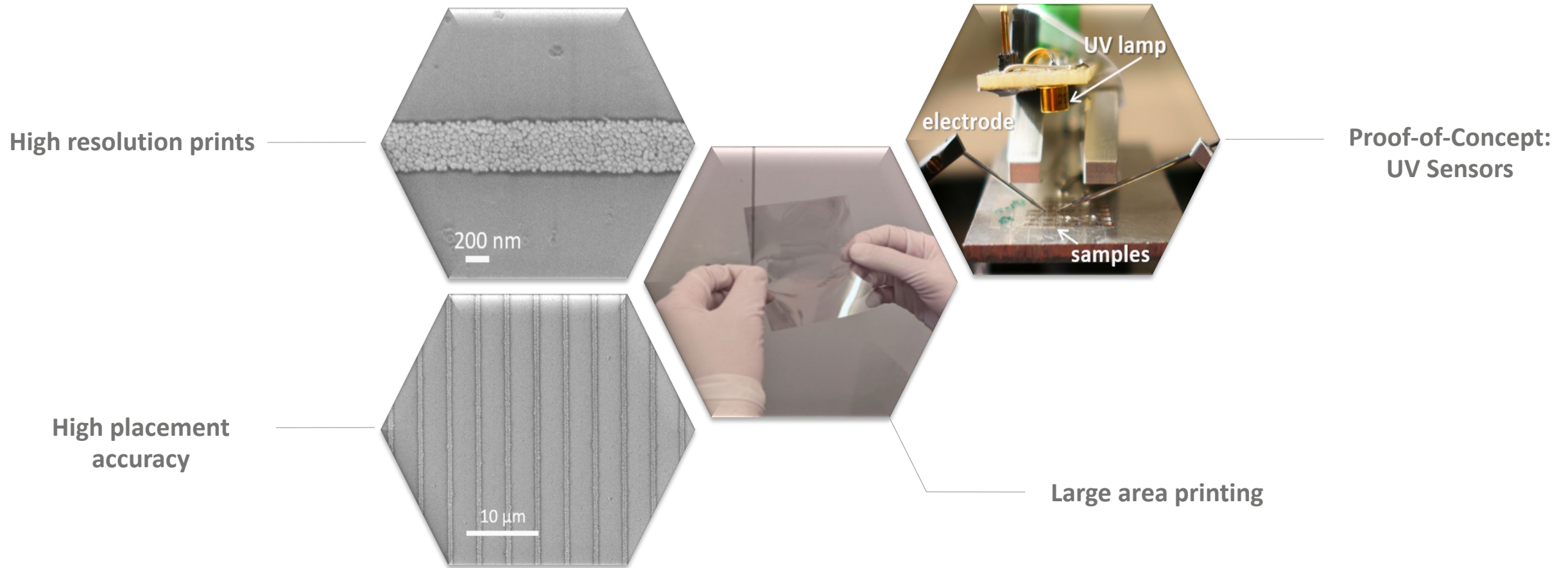
- screen printing,
- inkjet,
- aerosol jet
- gravure,
- flexography,
- offset,
- Etc.



Inveel Printing Technologies



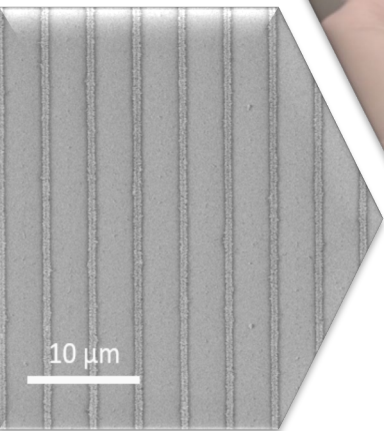
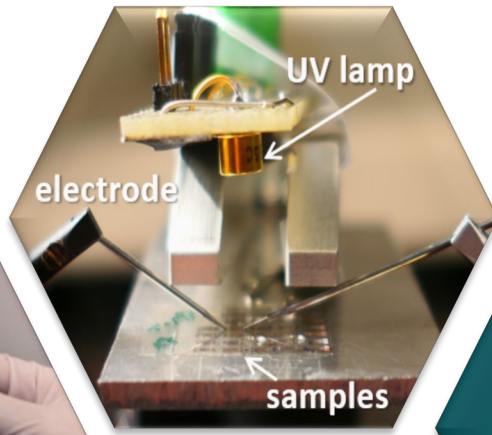
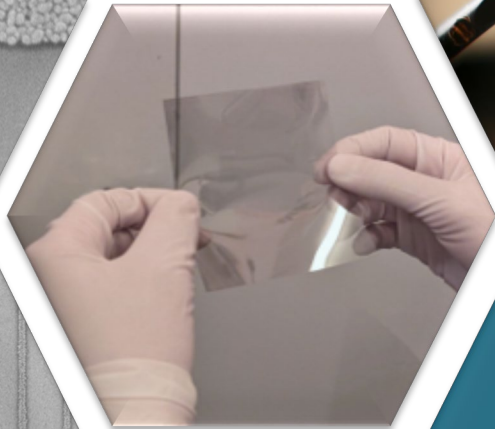
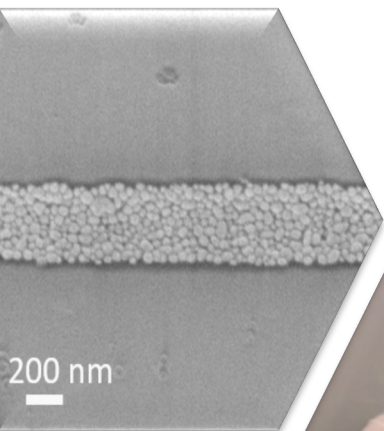
High-resolution printed electronics with linewidths in the 100s nm scale
Nanoelectronics on polymer surfaces



Inveel Printing Technologies



High-resolution printed electronics with linewidths in the 100s nm scale
Nanoelectronics on polymer surfaces



LOWEST PRINTING LINE WIDTH
130 nm → high sensitivity

VERY LOW RESISTIVITY
4.5 $\mu\Omega\cdot\text{cm}$ → fast response

HIGH TRANSMITTANCE
On transparent substrates

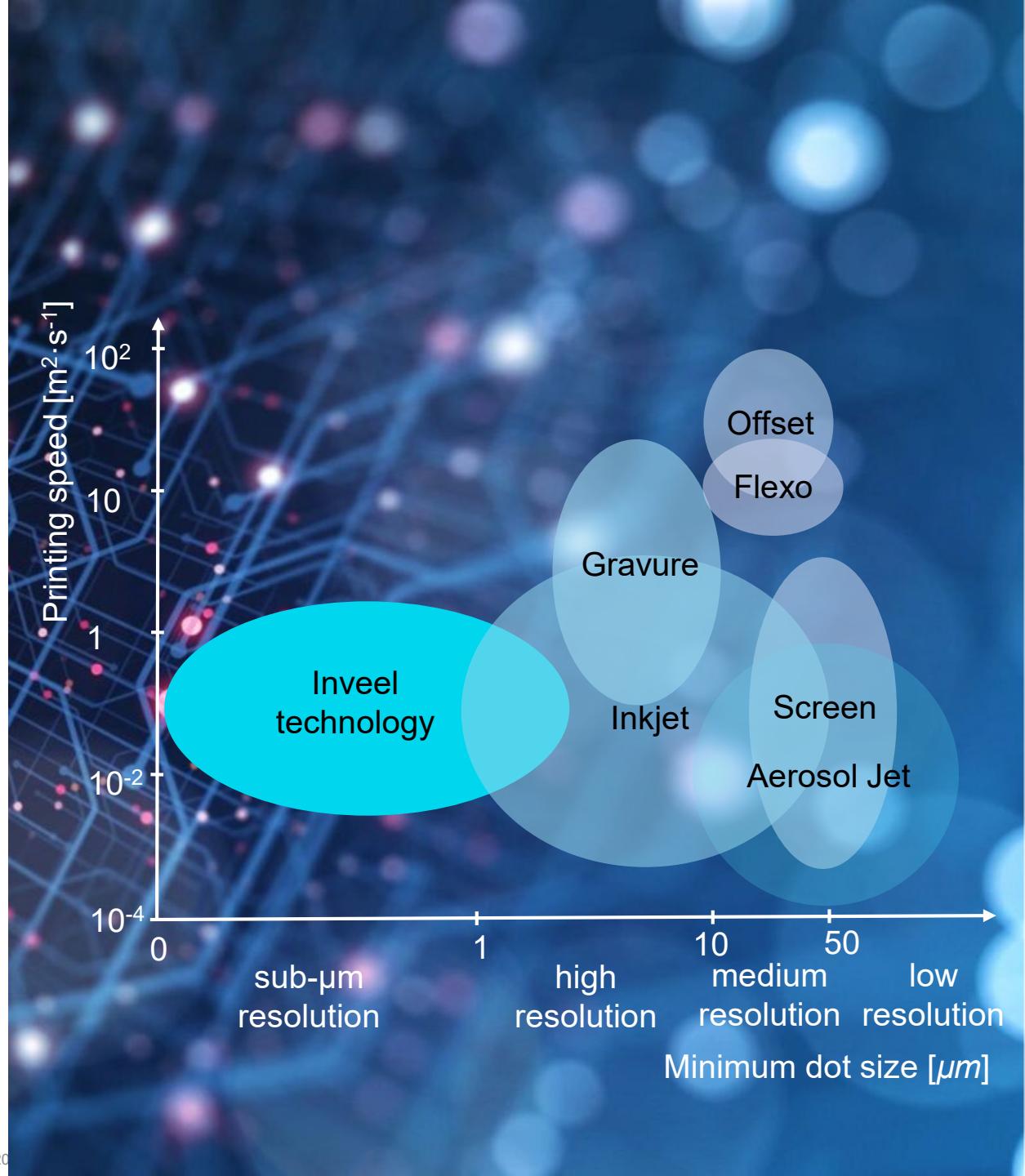
VARIETY OF SUBSTRATES
On flat/curved surfaces, flexible foils

COST-EFFICIENT & FAST
Easy scalability, High throughput

Comparison of printing methods

	INVEEL printing	Inkjet printing	Aerosol jet printing	Gravure printing
Minimum Linewidth	0.13 μm	1 μm	10 μm	5 μm
Throughput	80s/sheet	166 min/sheet	166 min/sheet	<0.1 s/sheet
UPH	45	0.36	0.36	54000
Bill of Materials (only ink)	0.005 CHF/sheet	0.013 CHF/sheet	1.13 CHF/sheet	0.32 CHF/sheet

*calculation is based on the thinnest achievable line width available for each of the presented technologies on a 10*10 cm² printed area with periodicity of 20 μm

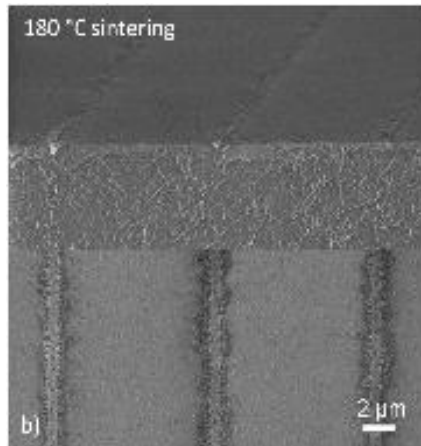
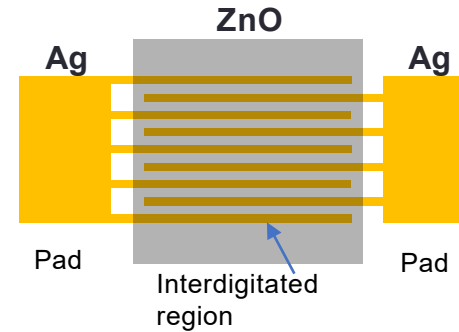


Proof of Concept: UV sensor



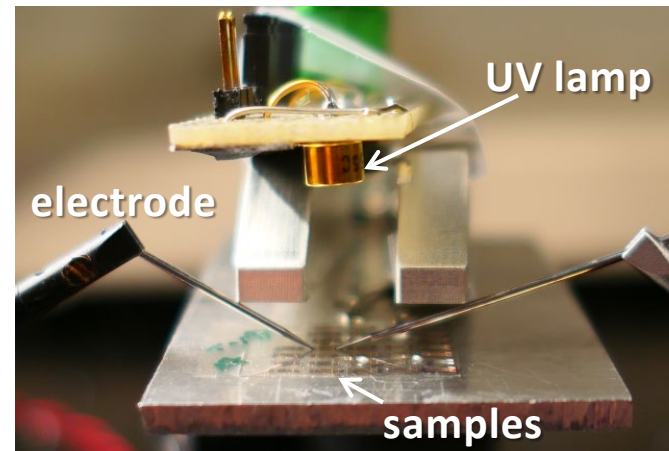
A simple application involving an interdigitated electrode array (IDEA)

- Sample size: 1 mm x 1 mm (interdigitated region)
- Wire width: 1 μm / 10 μm period
- ZnO semiconducting layer, 70 nm thickness
- Pad size: 0.5 x 1 mm
- UV light distance: 10 mm
- Wavelength: 355 and 385 nm

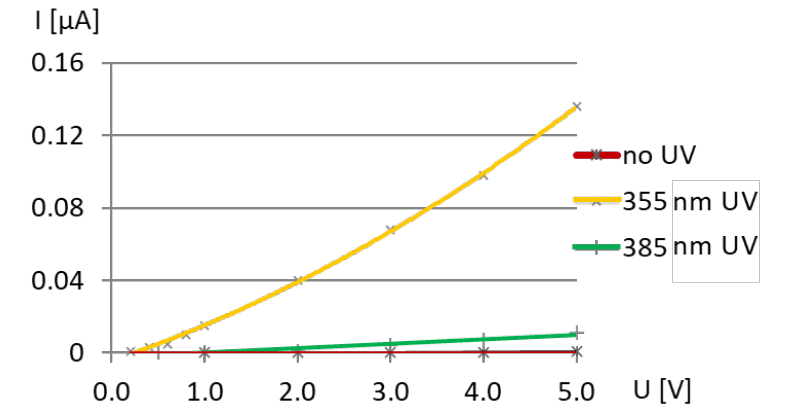


Cross-section

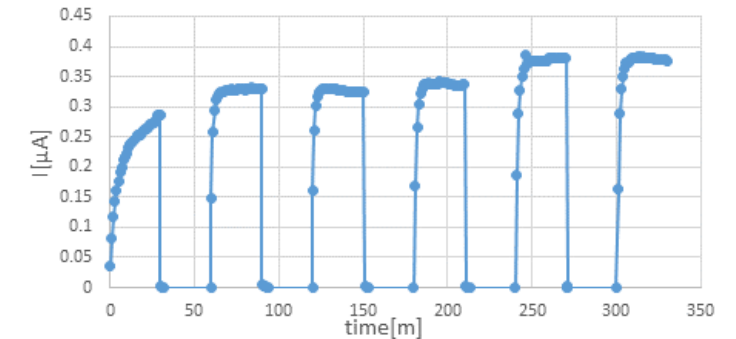
Top view



I-V curve measured in dark and in UV irradiation



Response/recovery curve



The working sensors prove that the IDEAs are free from shortcuts

Potential applications



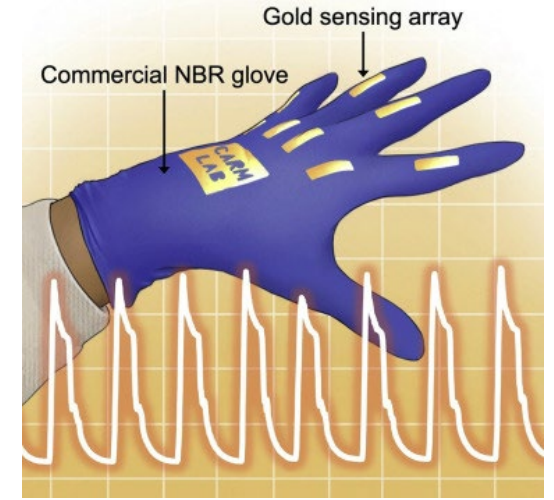
Smart windows



Electrochromic windows



Soft robotic skin



Human motion sensing



Polarizers

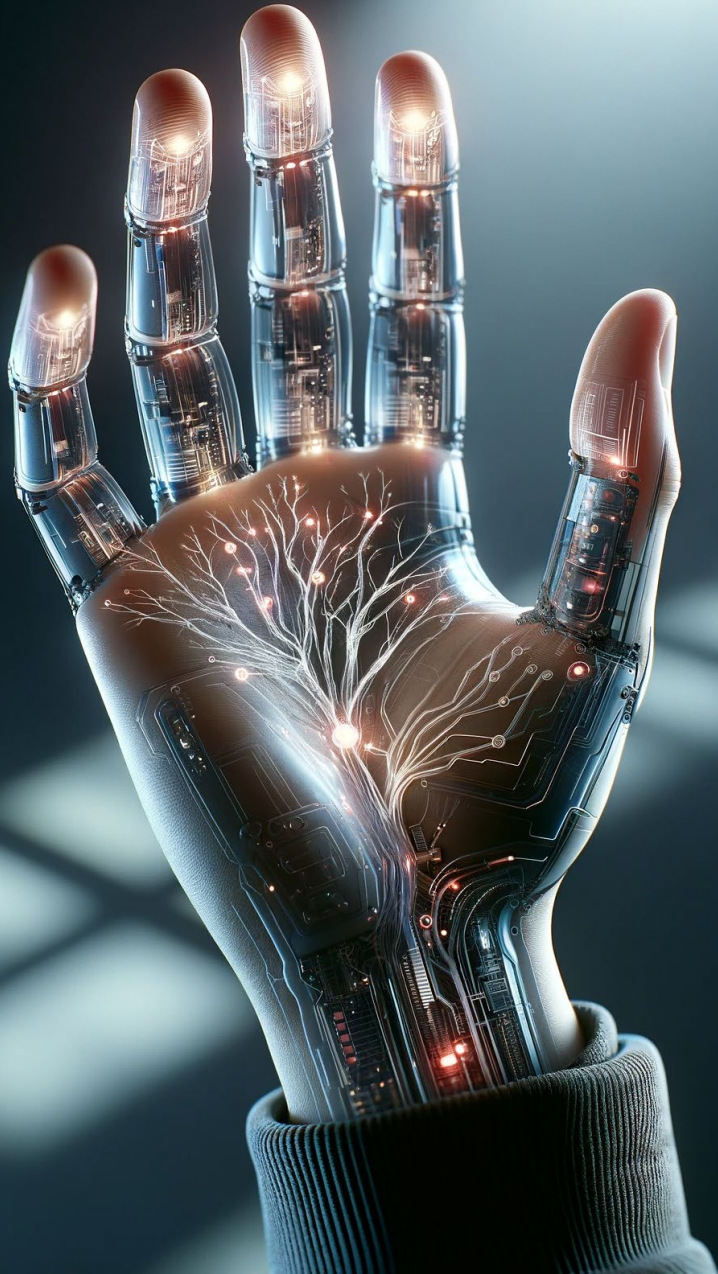


Structural health monitoring (Large area strain sensors)



Biosensors

Sensitive Robotic Skin



Gives robots the feeling of touch

- Large area soft skin with 1000s of integrated sensors
- High resolution sensor electrodes allow **high sensitivity** while efficiently operating on **low power**
- Shaped to perfectly fit all kinds of 3D surfaces (fingers, palm, knee, etc.)
- Customized sensor integration

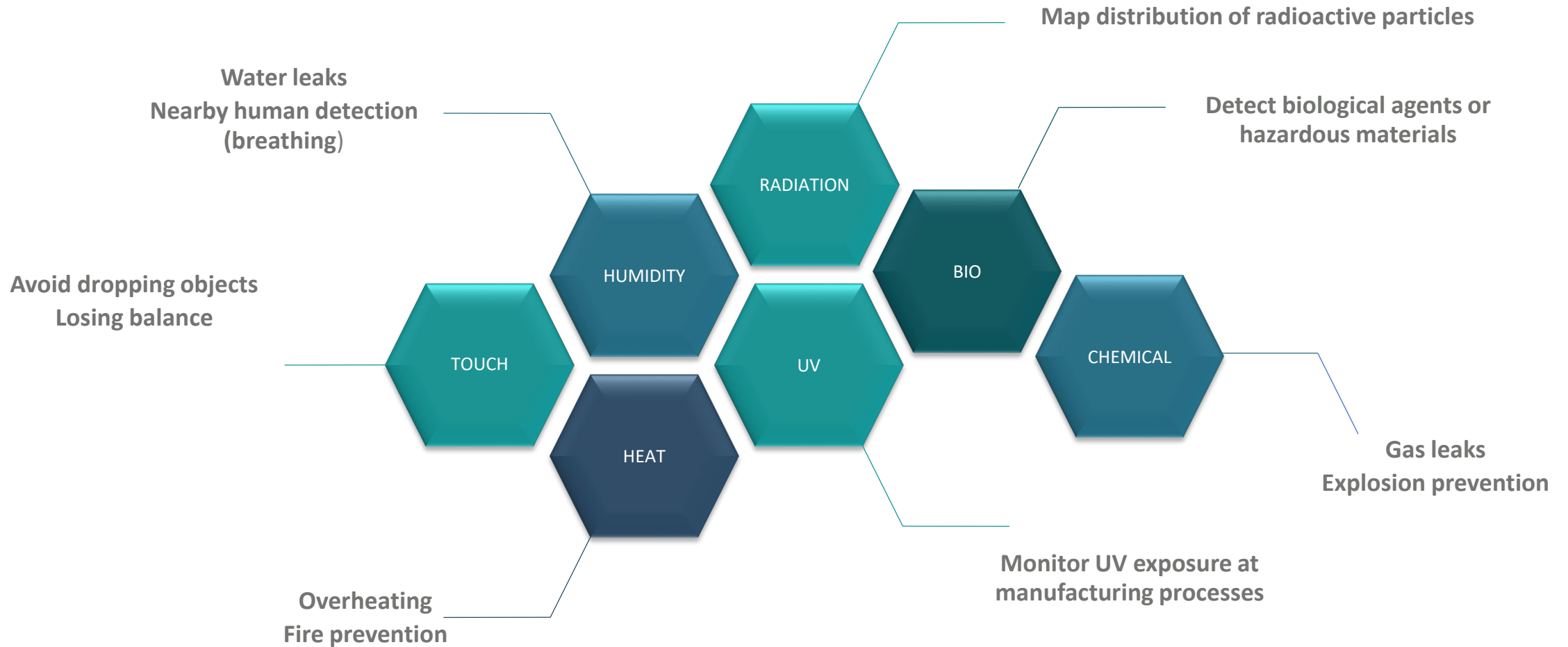
Touch | Heat | Humidity | UV | Gas | Biological matter | Radiation

Sensitive Robotic Skin



Gives robots the feeling of touch

and more !



Team

Management



Dr. Barbara Horvath
CEO/CTO



Chris Turpin
CIO/CFO

Engineering



Dr. Muhammad Refatul Haq
Postdoc



David Spichtig
Engineer Intern



Open position
Postdoc/Engineer
Hardware R&D



Advisory Board



Anil Sethi
Innosuisse Advisor



Dr. Helmut Schift
Technology Advisor PSI



Angelo Sozzi
PSI Advisor



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Thank you