



# **FlexFunction2Sustain**

**Open Innovation Ecosystem for Sustainable Nano-functionalized  
Flexible Plastic and Paper Surfaces and Membranes**

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## **TECHNICAL FACILITY SPECIFICATIONS**

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## Cluster 1: Vacuum Coating of Plastic and Paper Surfaces and Related Quality Control

### R2R sputtering Labflex® 200 (Fraunhofer FEP)

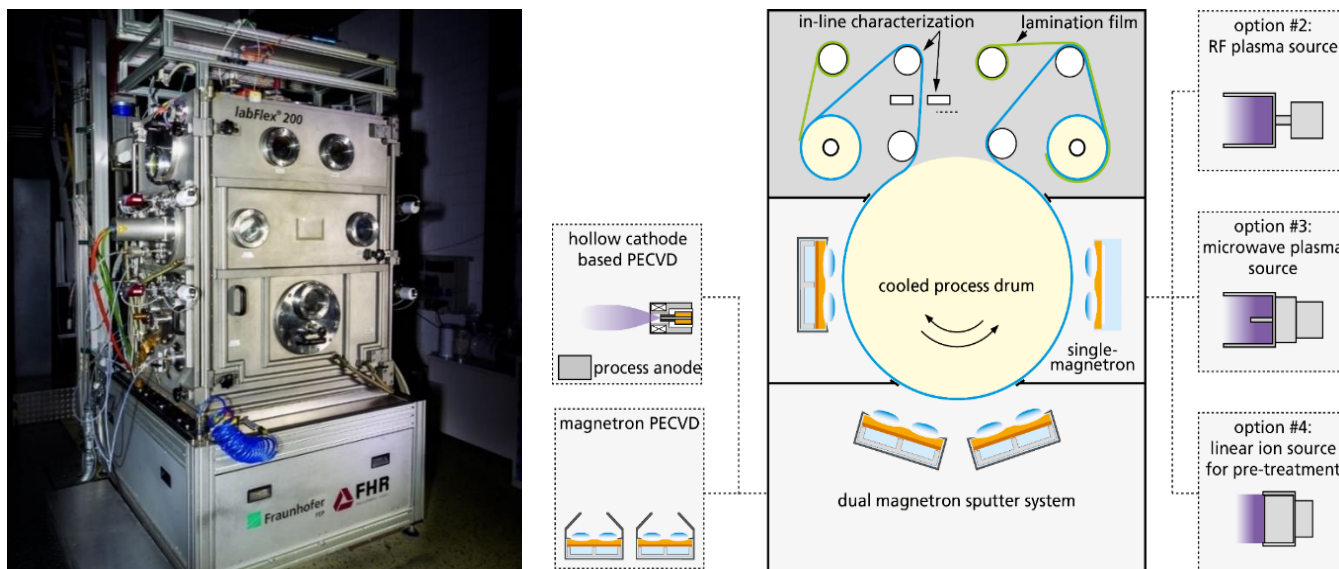


Figure 1: Picture and scheme of the labFlex® 200

Table 1: Machine parameters of the labFlex® 200

<b>Machine name</b>	labFlex® 200
<b>Machine type</b>	Vacuum roll-to-roll coater
<b>Substrate types to be processed</b>	Polymer films, metal foils, textiles
<b>Substrate dimension</b>	300mm material width; continuous roll
<b>Technologies available</b>	Sputtering, magPECVD, Plasma and ion treatment, arc PECVD Nano patterning by plasma processes
<b>Deposition materials available</b>	Metals and oxides Ag, Au, Ti, Al, ITO, ZnO:Al, TiO <sub>2</sub> , Al <sub>2</sub> O <sub>3</sub> and others on request
<b>Typical project fields</b>	Optical coatings, permeation barrier

## Vacuum coating machine NovoFlex® 600 (Fraunhofer FEP)

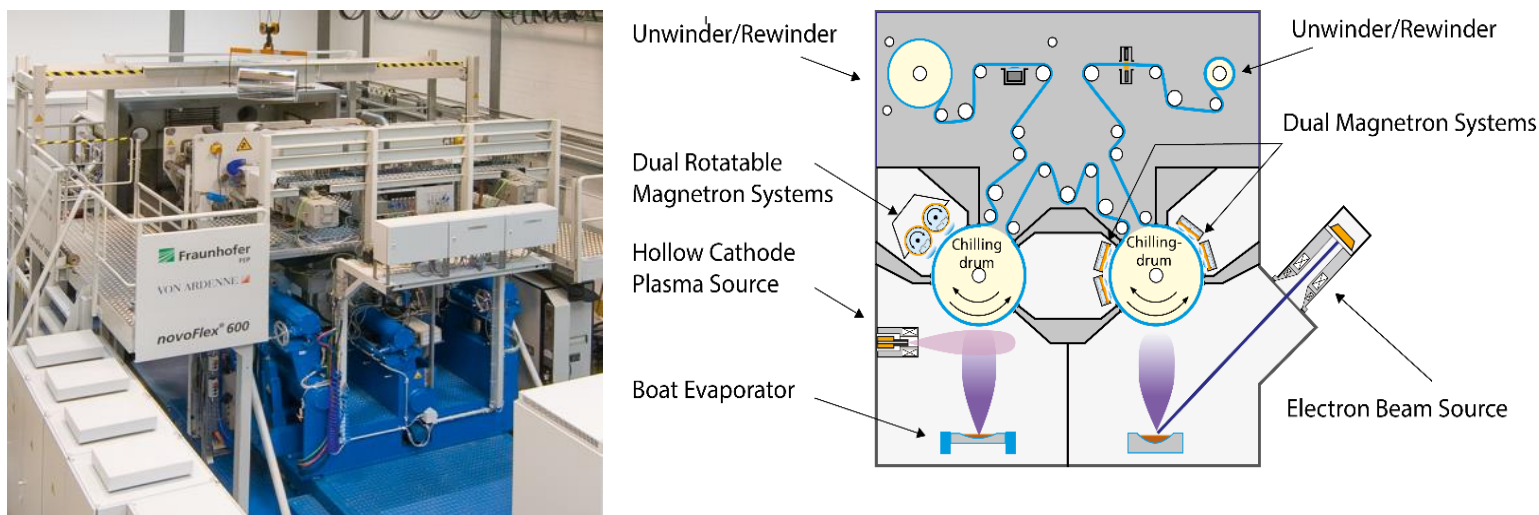


Figure 2: Picture and scheme of the novoFlex® 600

Table 2: Machine parameters of the novoFlex® 600

<b>Machine name</b>	novoFlex® 600
<b>Machine type</b>	Vacuum roll-to-roll coater
<b>Substrate to be processed</b>	Polymer films, metal foils, textiles
<b>Substrate dimension: Web width</b>	650 mm
<b>Substrate dimension: Deposition width</b>	600 mm
<b>Technologies available</b>	Electron Beam evaporation, boat evaporation, sputtering, Plasma and ion treatment, arc PECVD
<b>Deposition materials available</b>	Metals and oxides Al <sub>2</sub> O <sub>3</sub> , SiO <sub>2</sub> , Al, Si and others on request
<b>Typical project fields</b>	Optical coatings, permeation barriers, coatings for batteries

### LBnano (Fraunhofer FEP)

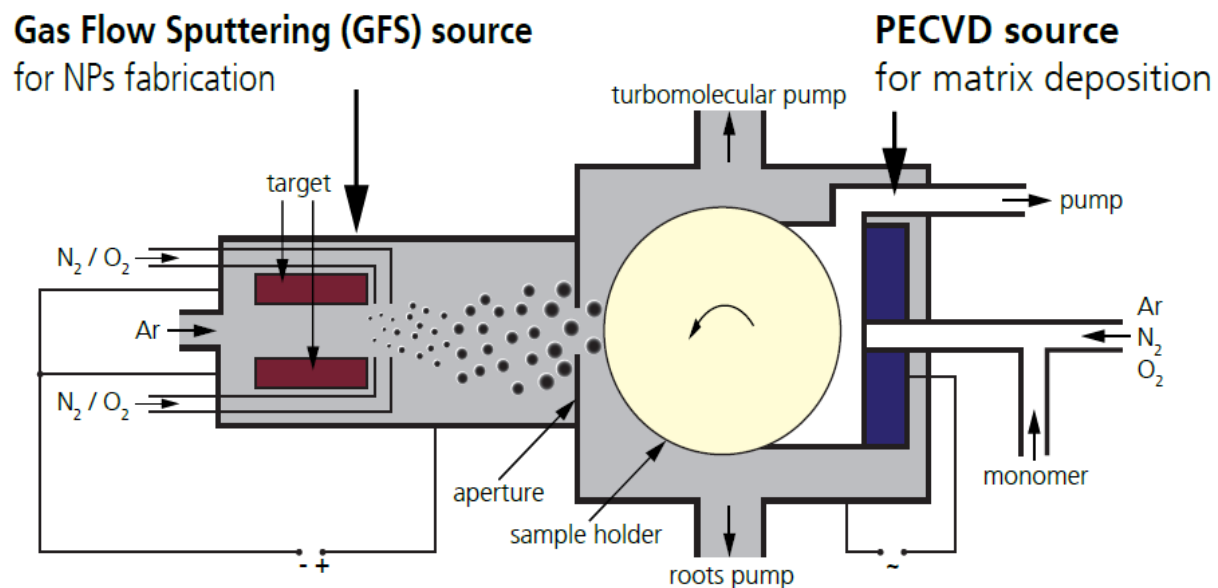


Figure 3: Scheme of the LBnano

Table 3: Machine parameters of the LB nano

<b>Machine name</b>	LB nano
<b>Machine type</b>	System for gas aggregation sputtering+PECVD for nanoparticles in matrix
<b>Substrate types to be processed</b>	sheets
<b>Substrate dimension:</b>	A4 size
<b>Technologies available</b>	Gas flow sputter source (sputtering + nanoparticle aggregation) PECVD
<b>Deposition materials available</b>	Ag- $SiO_x$
<b>Typical applications</b>	Sensors, PV systems, antibacterial layers

### Sheet-to-sheet atomic layer deposition (ALD) (Fraunhofer IAP)



Figure 4: Picture and scheme of sheet-to-sheet ALD unit

Table 4: Machine parameters of the sheet-to-sheet ALD unit

<b>Machine name</b>	Beneq TFS 200
<b>Machine type</b>	ALD deposition chamber connected inert glovebox system
<b>Substrate types to be processed</b>	Silicon wafers, glass substrates, plastic substrates
<b>Substrate dimension:</b>	150 x 150 mm
<b>Technologies available</b>	Atomic layer deposition (ALD)
<b>Deposition materials available</b>	ALD precursors for the deposition of Al <sub>2</sub> O <sub>3</sub> , TiO <sub>2</sub> , ZrO <sub>2</sub> , Pd,
<b>Typical project fields</b>	Organic electronic devices, barrier layer deposition

## Roll-to-roll atomic layer deposition (ALD) (Fraunhofer-IVV)

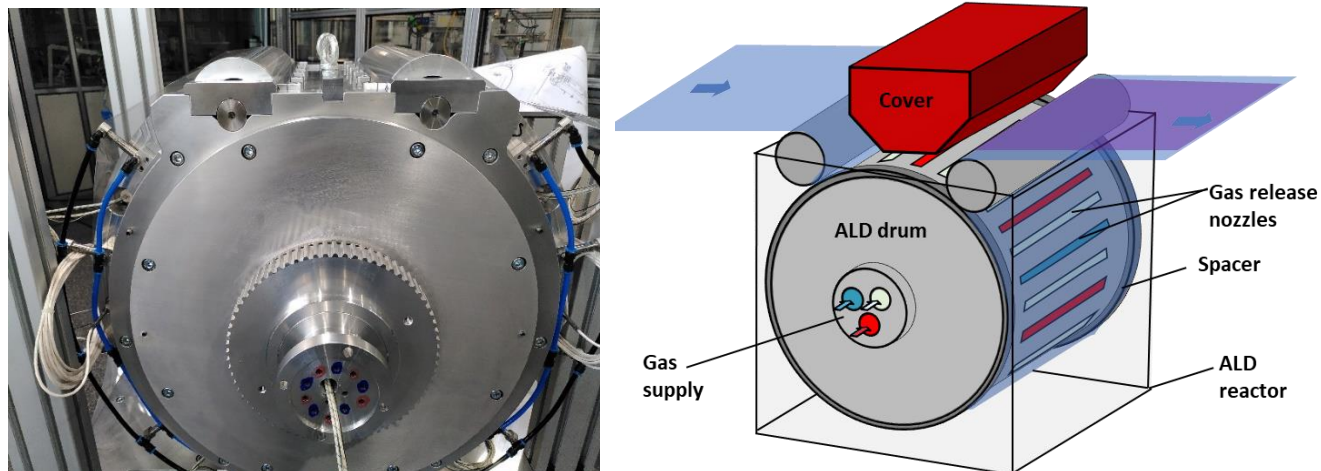


Figure 5: Picture and scheme of the roll-to-roll ALD system

Table 5: Machine parameters of the roll-to-roll ALD system

<b>Machine name</b>	Fraunhofer IVV – R2R ALD
<b>Machine type</b>	Roll-to-Roll Atomic Layer Deposition
<b>Substrate types to be processed</b>	Polymer films, metal foils
<b>Substrate dimension:</b>	Width: 335 - 370 mm Core: 3 and 6 in Roll diameter: up to 280 mm
<b>Technologies available</b>	Atmospheric Spatial ALD
<b>Deposition materials available</b>	Al <sub>2</sub> O <sub>3</sub>
<b>Typical applications</b>	Permeation barriers, coatings for batteries



## Sheet-to-sheet Magnetron sputter system (AUTH)



Figure 6: Picture and scheme of the sheet-to-sheet magnetron sputter system

Table 6: Machine parameters of the sheet-to-sheet magnetron sputter system

<b>Machine name</b>	High Vacuum Magnetron Sputtering Chamber
<b>Machine type</b>	Sheet-to-Sheet coating machine
<b>Substrate types to be processed</b>	Polymer films
<b>Substrate dimension:</b>	A4
<b>Technologies available</b>	Unbalanced Magnetron Sputtering High-power impulse magnetron sputtering
<b>Deposition materials available</b>	Metals (Al, Ti, Cr), Carbon, TiB <sub>2</sub> , Boron Nitride
<b>Typical applications</b>	Metallisation, Protective coatings, Antimicrobial Coatings (Ti-based and Diamond-Like Carbon)

## Cluster 2: Atmospheric Pressure Processes for Film Extrusion, Coatings, Lamination and Related Quality Control

### AtmoFlex 1250 (Fraunhofer FEP)

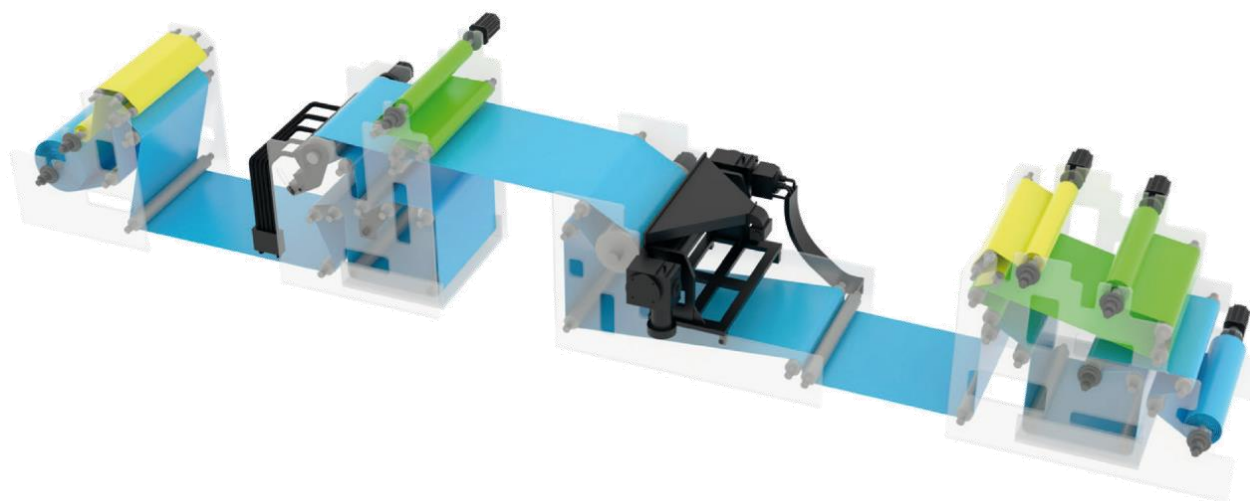


Figure 7: Scheme of the atmoFlex 1250

Table 7: Machine parameters of the atmoFlex 1250

<b>Machine name</b>	AtmoFlex 1250
<b>Machine type</b>	Roll-to-Roll coating
<b>Substrate types to be processed</b>	Polymer films
<b>Substrate dimension:</b>	Maximum 1250m working width, continuous roll
<b>Technologies available</b>	Electron beam Curing, Slot-die coating, R2R imprinting of structures from shim rolls
<b>Deposition materials available</b>	Various lacquer materials
<b>Typical applications</b>	Sustainable packaging



## R2R coating and lamination machine (Fraunhofer IVV)



Figure 8: (Left) Scheme of the roll-to-roll wet chemical coating and lamination pilot line at Fraunhofer IVV.  
(Right) Scheme of reverse gravure and slot-die coating technique

Table 8: Machine parameters of the roll-to-roll coating and deposition machine

<b>Machine name</b>	Fraunhofer IVV – R2R coating and lamination line
<b>Machine type</b>	Roll-to-Roll coating and lamination
<b>Substrate types to be processed</b>	Polymer films, paper, textiles
<b>Substrate dimension:</b>	Width: up to 480 mm, Core: 3 and 6 in Roll diameter: up to 400 mm
<b>Technologies available</b>	Slot-die coating, Reverse gravure coating, Lamination unit, UV-Curing, convection dryer, primer station
<b>Deposition materials available</b>	Water and solvent based lacquers and adhesives
<b>Typical application</b>	Flexible films for food packaging, films for technical applications,

### Click and Coat® based pilot lines: CC08 and LS29 (COATEMA)

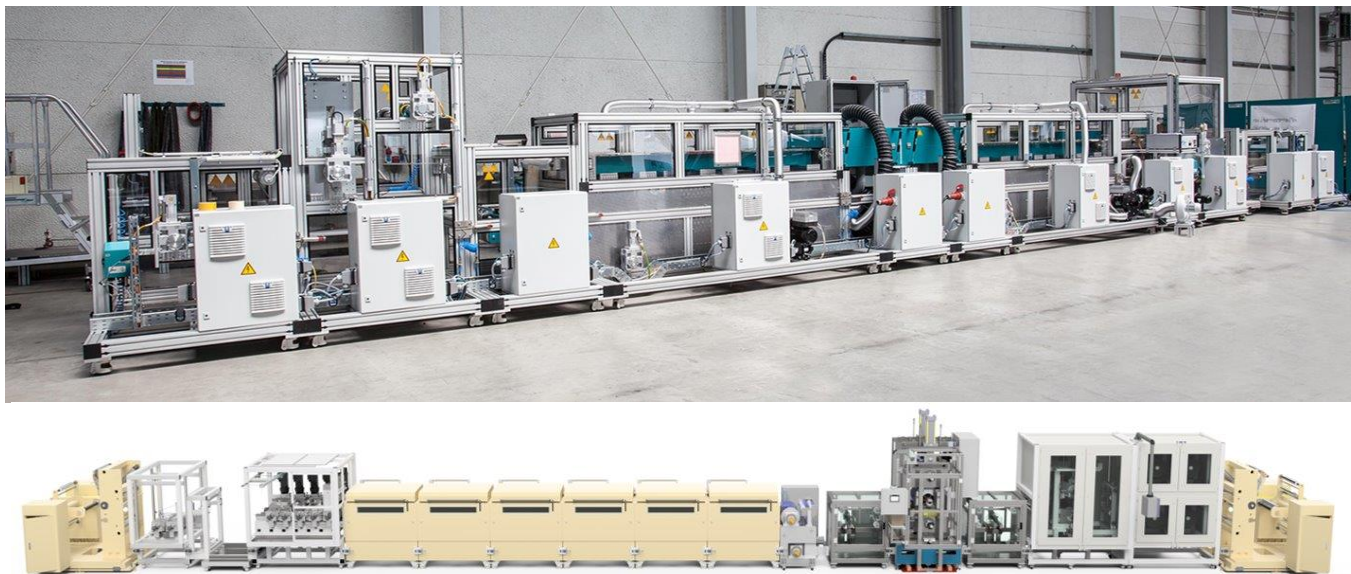


Figure 9: Pictures of the Click and Coat® based pilot lines

Table 9: Machine parameters of the Click and Coat® based pilot lines

<b>Machine name</b>	LS29, CC08
<b>Machine type</b>	Roll-to-Roll coating
<b>Substrate types to be processed</b>	Various types (e.g., polymer films, cellulose based films, etc.)
<b>Substrate dimension:</b>	Maximum 550 mm working width, continuous roll
<b>Technologies available</b>	Slot die coating, knife coating, screen printing, gravure printing, flexographic printing, 5 roller coating, corona treatment, Calendaring, Inertcalendaring, inert lamination, thermal NIL, floatation dryers, radiation dryers (UV, IR),
<b>Deposition materials available</b>	Wide range of different materials
<b>Typical applications</b>	Sustainable packaging, Nanocellulose barrier coating, fuel cells, membrane printing, printed electronics, pharmaceutical products

## Ultrasonic Spray Coating (INL)



Figure 10: Picture and scheme of the ultrasonic spray coating machine

Table 10: Machine parameters of the ultrasonic spray coating machine

<b>Machine name</b>	Sono-Tek ExactaCoat and customised R2R Sono-Tek Versicoat
<b>Machine type</b>	ExactaCoat: Substrate-to-Substrate coating Versicoat: Roll-to-Roll coating
<b>Substrate types to be processed</b>	ExactaCoat: Sheets/flat substrates Versicoat: films/paper rolls
<b>Substrate dimension:</b>	ExactaCoat: 30 x 30 cm Versicoat: rolls up to 60 cm width
<b>Technologies available</b>	Ultrasonic spray coating
<b>Deposition materials available</b>	Various, upon consultation, including biopolymer-based coatings
<b>Typical applications</b>	Sustainable coatings and surface functionalization solutions for food packaging, agriculture, green electronics, or medical devices (e.g., bio-based food packaging with enhanced barrier or antimicrobial surfaces).

## Nanoparticle deposition system (BLNano)

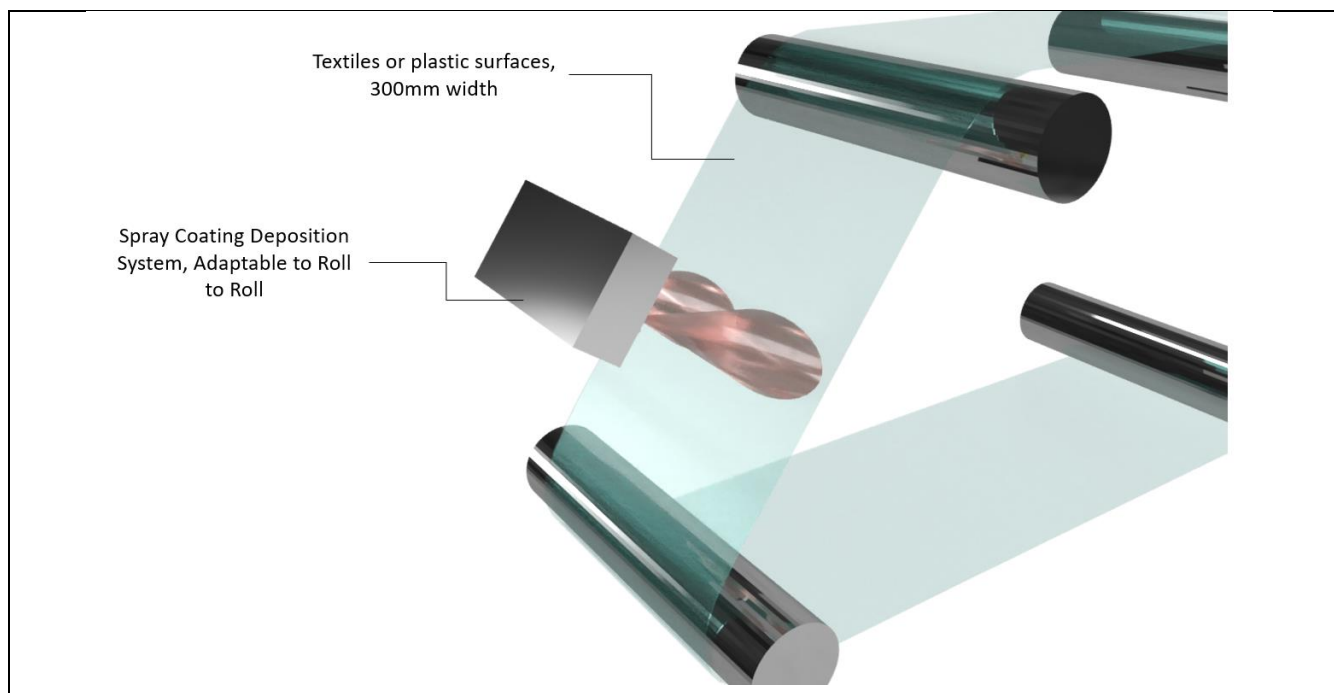


Figure 11: Picture and scheme of the nanoparticle deposition system

Table 11: Machine parameters of the nanoparticle deposition system

<b>Machine name</b>	Nanoparticle deposition system
<b>Machine type</b>	Spray Coating Adaptable to Roll-to-Roll
<b>Substrate types to be processed</b>	Textiles, plastic substrates
<b>Substrate dimension:</b>	300mm width of the roll
<b>Technologies available</b>	Spray Coating Technique, Nanoparticle Deposition
<b>Deposition materials available</b>	Polymeric Inorganic Nanoparticles, Antimicrobial Nanocomposites
<b>Typical applications</b>	Antimicrobial Surface Coating



### Cluster 3: Facilities for nano-structuring of surfaces

#### R2R UV Nanoimprint pilot line (JOANNEUM RESEARCH)



Figure 12 Roll-to-roll machine for UV nanoimprint lithography at JOA

Table 12: Machine parameters of the UV nanoimprint lithography

<b>Machine name</b>	Basecoater BC44
<b>Machine type</b>	Roll-to-Roll coating and UV nanoimprint lithography
<b>Substrate types to be processed</b>	Polymer films (including recycled PET and cellulose based film)
<b>Substrate dimension:</b>	Width of the roll upto 300 mm, Thickness range 20 – 250 µm
<b>Technologies available</b>	R2R rotogravure coating and printing, UV Nanoimprint lithography; web speed 0.5 to 30 m/min
<b>Deposition materials available</b>	UV curable resins (including biobased UV curable resins). NILcure®
<b>Typical project fields</b>	Optical films, Security features, Freeform micro-optics, Lighting, Displays & Photovoltaics, 3D printing, Microfluidics, Point-of-Care diagnostics, Lab-on-Foil, Biomimetic/bionic structures

The FlexFunction2Sustain service portfolio at JOANENUM RESEARCH is now updated as follow: nano- and micro (optical) structuring of PET, recycled PET, and cellulose based surfaces by the use of R2R UV-NIL machines with inline quality and process control.

## Laser Structuring Facility (AUTH)



Figure 13: Picture of the laser structuring facility

Table 13: Machine parameters of the Laser Structuring Facility

<b>Machine name</b>	Laser Structuring Facility
<b>Machine type</b>	Scanning R2R Ultra-Short Pulse Laser System
<b>Substrate types to be processed</b>	Polymers, Metals, Paper
<b>Substrate dimension:</b>	300 mm wide rolls, Installed in R2R Pilot-Line, A4
<b>Technologies available</b>	Picosecond Laser, First & Second Harmonic (1064 nm and 532 nm)
<b>Deposition materials available</b>	
<b>Typical applications</b>	Laser processing of printed polymers, Transparent Conductive Oxides, Metals, Development of Noble Metal Colloidal Nanoparticles based on Laser Ablation in Solvents Laser scribing for application in Organic Photovoltaics & OLEDs



### Nano-Imprint-Lithography test facilities (Coatema)



Figure 14: Picture of the NIL test facility

Table 14: Machine parameters of the NIL test facility

<b>Machine name</b>	Thermal nanoimprint module (Can be integrated into CC08 and LS29)
<b>Machine type</b>	Roll-to-Roll lamination
<b>Substrate types to be processed</b>	Various types (e.g., polymer films, cellulose based films, etc.)
<b>Substrate dimension:</b>	Maximum 550 mm working width, continuous roll
<b>Technologies available</b>	Nitrogen protective atmosphere, inert lamination
<b>Deposition materials available</b>	Wide range of materials
<b>Typical applications</b>	optical security films, degradable packaging, recyclable packaging

## Cluster 4: Facilities for Smart Functionality (Printed Electronics) on Paper and Plastic, and Inline Quality Control (AUTH)

### Flexible printed electronics line (AUTH)



Figure 15 Picture of of Printed Electronics R2R pilot to production line at AUTH

Table 15: Machine parameters of flexible printed electronics line

<b>Machine name</b>	Printed electronics line
<b>Machine type</b>	Roll-2-Roll printed electronics pilot Line
<b>Substrate types to be processed</b>	Polymer films
<b>Substrate dimension:</b>	300 mm coating width
<b>Technologies available</b>	inkjet printing; slot-die coating; flexo-printing, screen and gravure printing, Laser structuring, UV-NIL, In-line metrology techniques (Spectroscopic Ellipsometry, Raman, Eddy Current, OES
<b>Deposition materials available</b>	Polymers
<b>Typical applications</b>	Printed electronics (OPVs)

**OVPD machine (AUTH)**

Table 16: Machine parameters of OPVD machine

<b>Machine name</b>	Organic Vapour Phase Deposition (OVPD)
<b>Machine type</b>	OVPD Pilot-to-Production Line
<b>Substrate types to be processed</b>	Glass, Polymer
<b>Substrate dimension:</b>	20x20 cm
<b>Technologies available</b>	Deposition of Organic small molecules based on the gas phase transport principle, In-line metrology tools (Spectroscopic Ellipsometry and Raman Spectroscopy (RS))
<b>Deposition materials available</b>	Organic small molecules
<b>Typical applications</b>	Printed electronics (OPVs & OLEDs)

## Sheet-2-Sheet printed electronics line (Fraunhofer IAP)

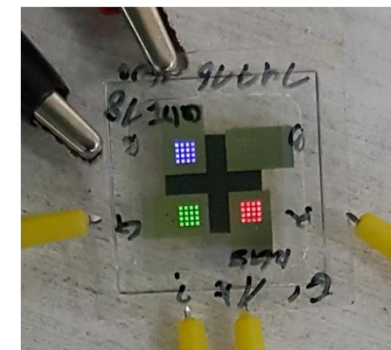
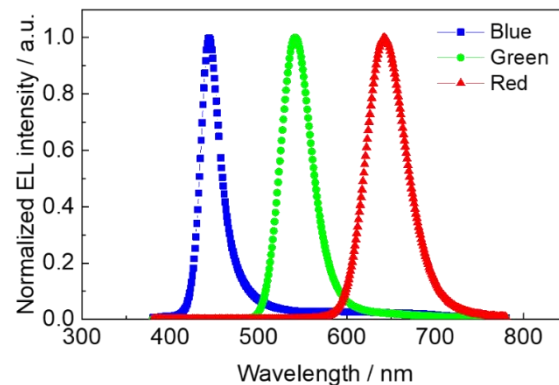
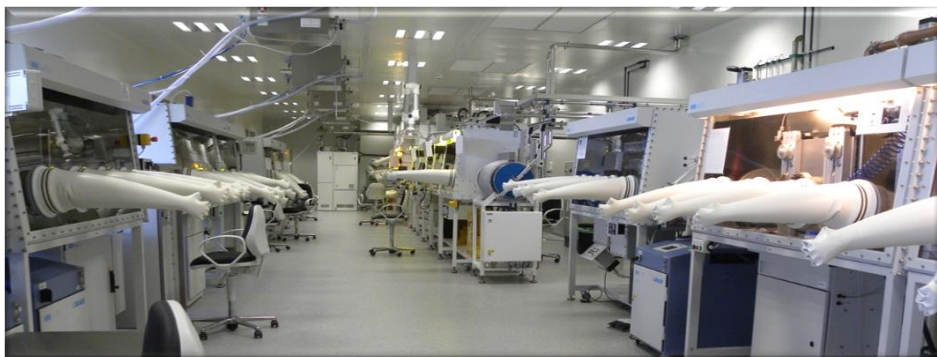


Figure 16 Picture of the clean room with the organic electronic pilot line in the back on the left hand side (upper picture) and results from the inkjet printed QD-LEDs processed in the organic electronic pilot line

Table 17: Machine parameters of sheet-to-sheet line

<b>Machine name</b>	Printed electronics pilot line
<b>Machine type</b>	Sheet-2-Sheet
<b>Substrate types to be processed</b>	Polymer films
<b>Substrate dimension:</b>	150 x 150 mm
<b>Technologies available</b>	ALD encapsulation, Inkjet printing, slot die coating, vacuum evaporation, encapsulation of organic electronic (OE) devices
<b>Deposition materials available</b>	Different precursors for the deposition of barrier layers by ALD, charge carrier materials and active materials for solution processing of OE devices (OLEDs, OPV, perovskite solar cells), metals such as Ag, Al, Ca, Ba for thermal evaporated electrodes
<b>Typical applications</b>	Printed electronics