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FlexFunction2Sustain

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

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Executive summary and full list of collected facility specifications

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RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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Executive Summary

Technical specification (available processes, substrate sizes, productivity data) for the FlexFunction2Sustain OITB service portfolio are compiled.

This Factsheet (to be available to the public via the Flexfunction2Sustain web page) summarizes all machine capabilities and possible performances to be used as marketing instrument to attract clients to the FlexFunction2Sustain OITB.

This concerns the Lab-to-Fab facilities fort nano-functionalisation plastic and paper surfaces and membranes, specifically the machines from the vacuum coating cluster as well as the atmospheric pressure coating cluster, the nano-structuring and the organic electronics part.

Table of Contents

1. Introduction

This deliverable provides an overview of the facilities involved in the open innovation testbed. The deliverable provides all the necessary information in a way which is easily conceivable for external parties. The deliverable is structured in 4 sections corresponding to the four clusters used in WP2 Lab-to-Fab facilities for nano-functionalisation plastic and paper surfaces and membranes:

1. Vacuum coating equipment
2. Atmospheric pressure equipment
3. Nano-Structuring equipment
4. Printed electronics-related equipment

Altogether 17 facilities are listed. These facilities are operated by seven different partners:

- Fraunhofer FEP
- Fraunhofer IVV
- Fraunhofer IAP
- INL
- AUTH
- BLNano
- Coatema

The information for each of the facilities is provided in a similar form. A figure is included showing the machine itself, preferably by a picture and a scheme. A table is summarizing the main machine information. It conveys information about available technologies and the substrate type and size. The responsible party is included in the headline of each section. In any case, the deliverable is focused on a quick overview. Detailed information needs to be requested by the interested parties during the discussion of potential projects.

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

2.1. R2R sputtering Labflex® 200 (Fraunhofer FEP)

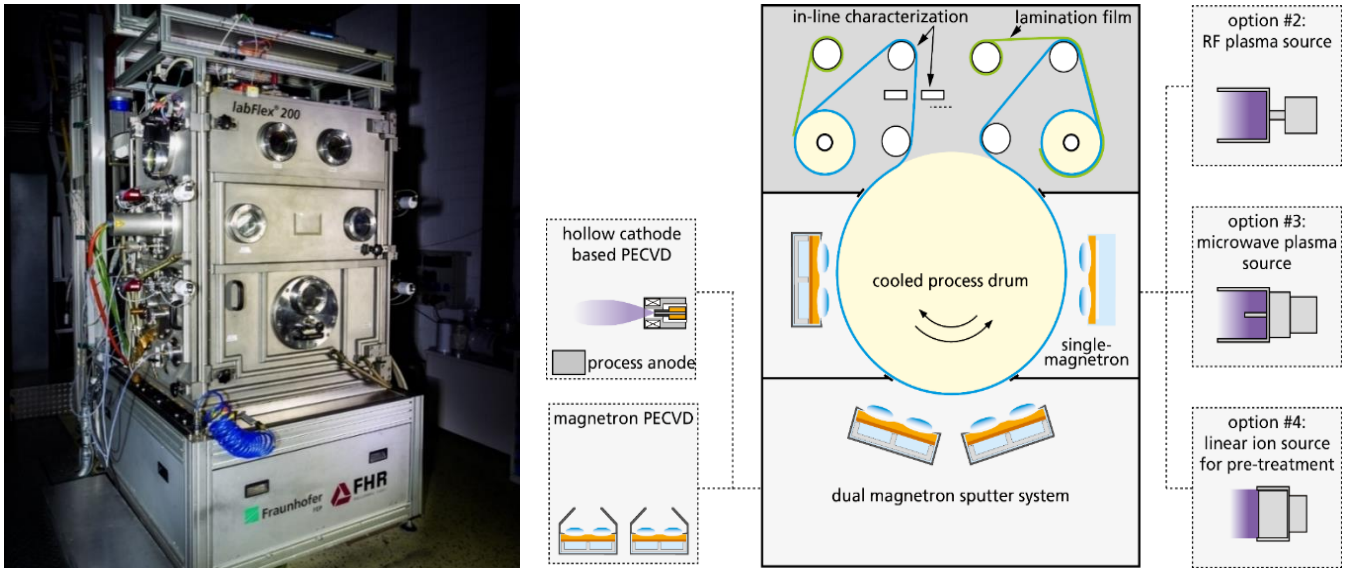


Figure 1: Picture and scheme of the labFlex® 200

Table 1: Machine parameters of the labFlex® 200

Machine name	labFlex® 200
Machine type	Vacuum roll-to-roll coater
Substrate types to be processed	Polymer films, metal foils, textiles
Substrate dimension	300mm material width; continuous roll
Technologies available	Sputtering, magPECVD, Plasma and ion treatment, arc PECVD Nano patterning by plasma processes
Deposition materials available	Metals and oxides Ag, Au, Ti, Al, ITO, ZnO:Al, TiO2, Al2O3 and others on request
Typical project fields	Optical coatings, permeation barrier

2.2. Vacuum coating machine NovoFlex® 600 (Fraunhofer FEP)

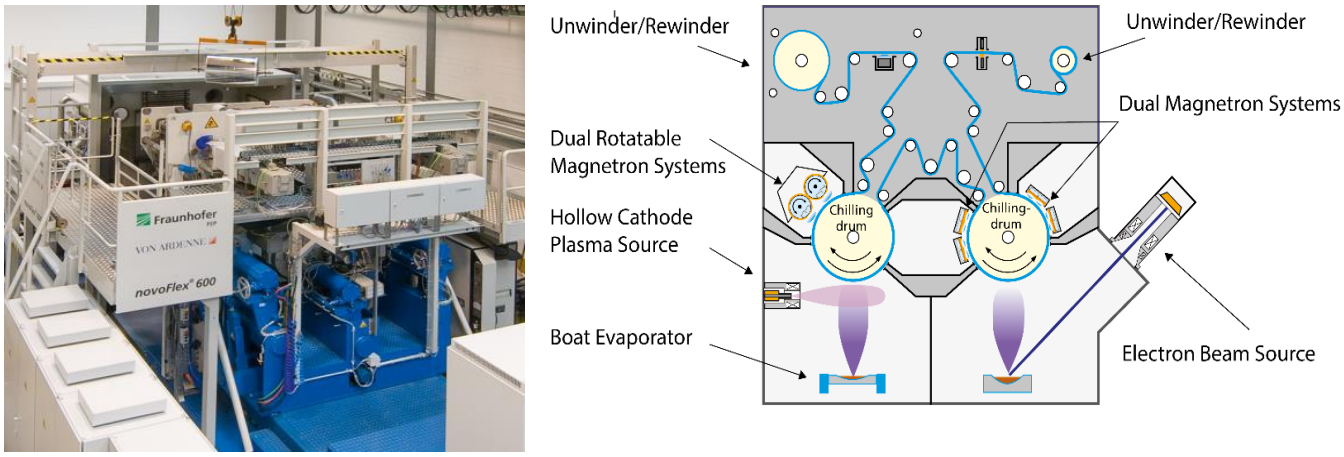


Figure 2: Picture and scheme of the novoFlex® 600

Table 2: Machine parameters of the novoFlex® 600

Machine name	novoFlex® 600
Machine type	Vacuum roll-to-roll coater
Substrate to be processed	Polymer films, metal foils, textiles
Substrate dimension: Web width	650 mm
Substrate dimension: Deposition width	600 mm
Technologies available	Electron Bean evaporation, boat evaporation, sputtering, Plasma and ion treatment, arc PECVD
Deposition materials available	Metals and oxides Al_2O_3, SiO_2, Al, Si and others on request
Typical project fields	Optical coatings, permeation barriers, coatings for batteries

2.3. LBnano (Fraunhofer FEP)

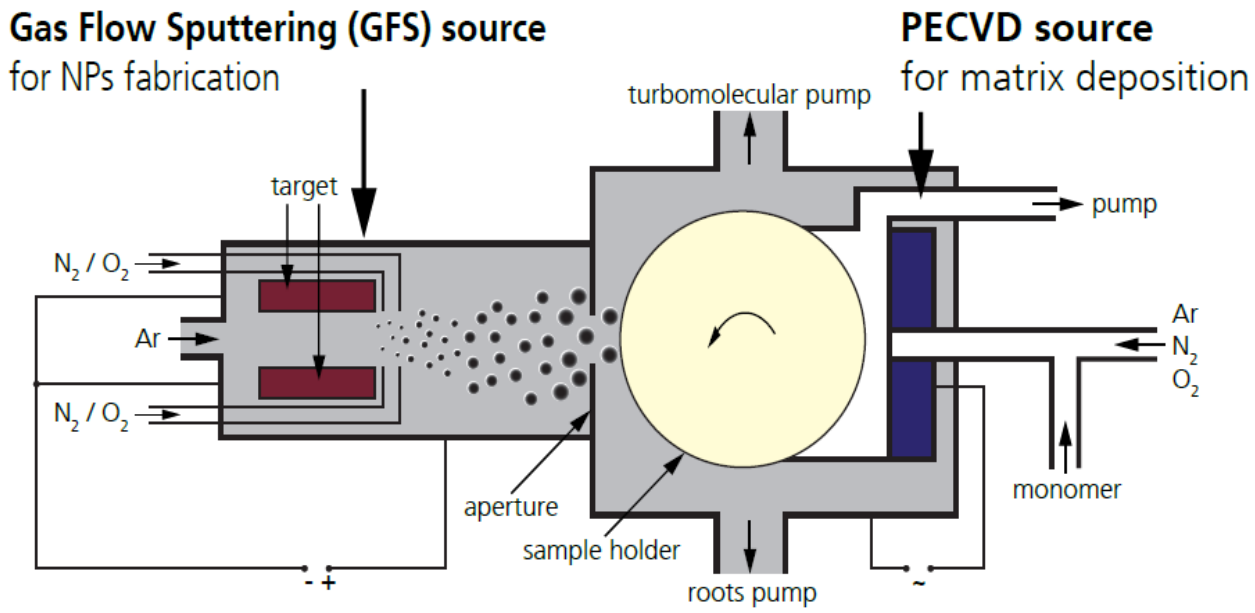


Figure 3: Scheme of the LBnano

Table 3: Machine parameters of the LB nano

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

2.4. 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

Machine name	Beneq TFS 200
Machine type	ALD deposition chamber connected inert glovebox system
Substrate types to be processed	Silicon wafers, glass substrates, plastic substrates
Substrate dimension:	150 x 150 mm
Technologies available	Atomic layer deposition (ALD)
Deposition materials available	ALD precursors for the deposition of Al_20_3, TiO_2, ZrO_2, Pd,
Typical project fields	Organic electronic devices, barrier layer deposition

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

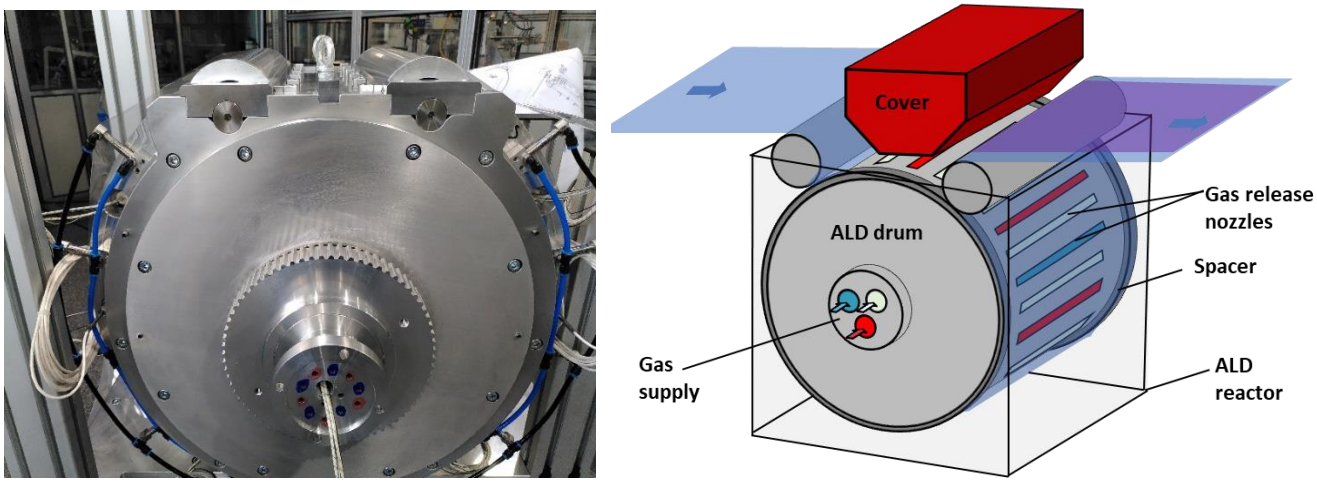


Figure 5: Picture and scheme of the roll-to-roll ALD system

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

Machine name	Fraunhofer IVV – R2R ALD
Machine type	Roll-to-Roll Atomic Layer Deposition
Substrate types to be processed	Polymer films, metal foils
Substrate dimension:	Width: 335 - 370 mm Core: 3 and 6 in Roll diameter: up to 280 mm
Technologies available	Atmospheric Spatial ALD
Deposition materials available	Al_2O_3
Typical applications	Permeation barriers, coatings for batteries

2.6. 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

Machine name	High Vacuum Magnetron Sputtering Chamber
Machine type	Sheet-to-Sheet coating machine
Substrate types to be processed	Polymer films
Substrate dimension:	A4
Technologies available	Unbalanced Magnetron Sputtering High-power impulse magnetron sputtering
Deposition materials available	Metals (Al, Ti, Cr), Carbon, TiB2, Boron Nitride
Typical applications	Metallisation, Protective coatings, Antimicrobial Coatings (Ti-based and Diamond-Like Carbon)

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

3.1. AtmoFlex 1250 (Fraunhofer FEP)

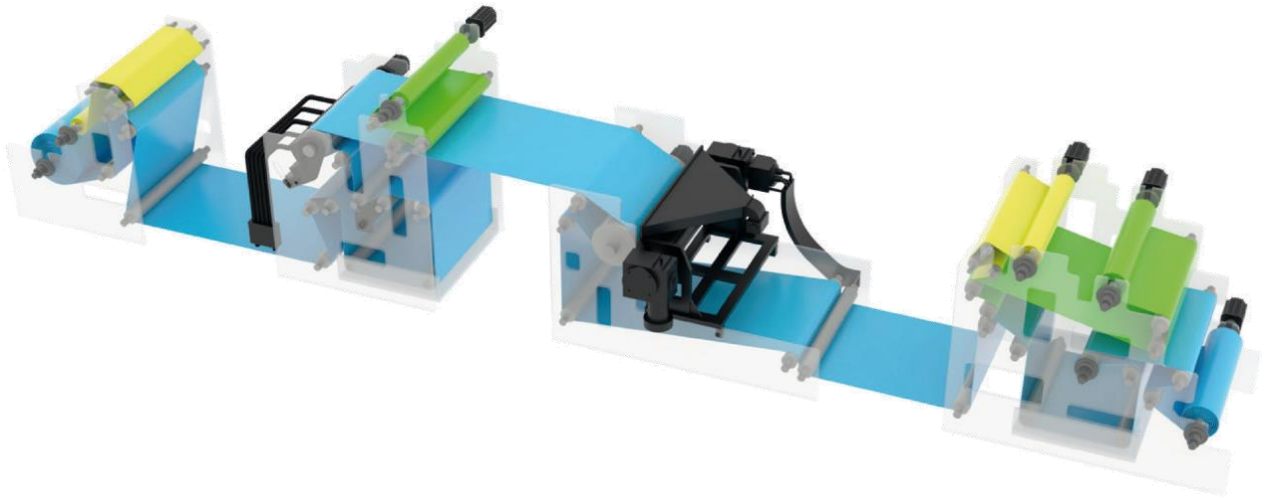


Figure 7: Scheme of the atmoFlex 1250

Table 7: Machine parameters of the atmoFlex 1250

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

3.2. R2R coating and lamination machine (Fraunhofer IVV)

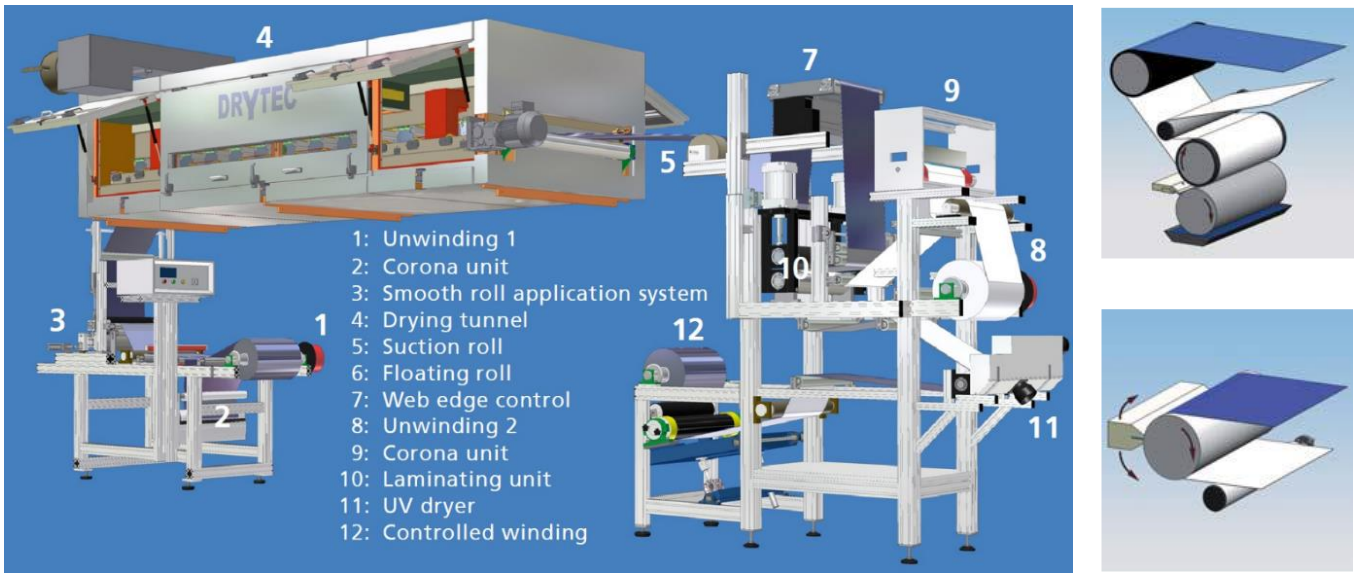


Figure 8: (Left) Scheme of the roll-to-roll wet chemical coating and lamination pilot line at Fraunhofer IVV. (Right) Scheme of reverse gravure and slot-die coating technique

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

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

3.3. 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

Machine name	LS29, CC08
Machine type	Roll-to-Roll coating
Substrate types to be processed	Various types (e.g., polymer films, cellulose based films, etc.)
Substrate dimension:	Maximum 550 mm working width, continuous roll
Technologies available	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),
Deposition materials available	Wide range of different materials
Typical applications	Sustainable packaging, Nanocellulose barrier coating, fuel cells, membrane printing, printed electronics, pharmaceutical products

3.4. Ultrasonic Spray Coating (INL)

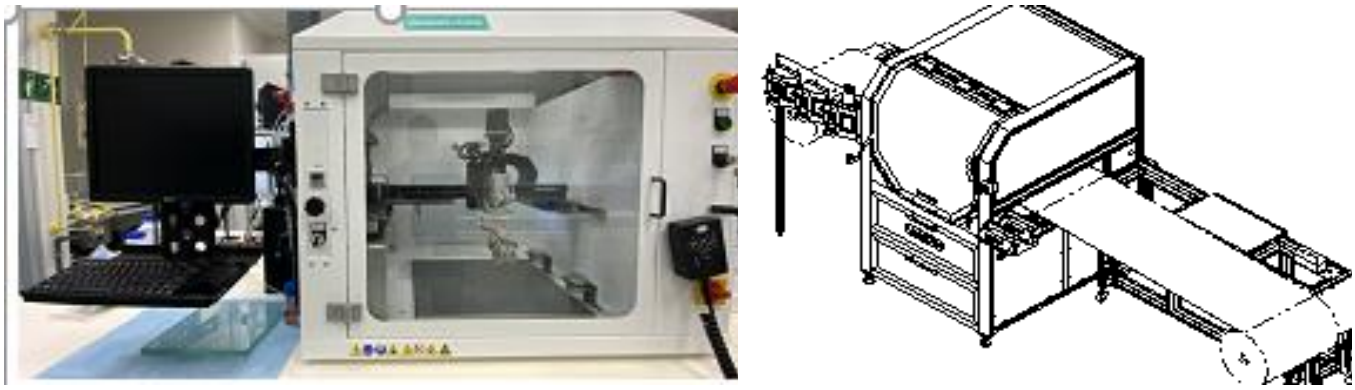


Figure 10: Picture and scheme of the ultrasonic spray coating machine

Table 10: Machine parameters of the ultrasonic spray coating machine

Machine name	Sono-Tek ExactaCoat and customised R2R Sono-Tek Versicoat
Machine type	ExactaCoat: Substrate-to-Substrate coating Versicoat: Roll-to-Roll coating
Substrate types to be processed	ExactaCoat: Sheets/flat substrates Versicoat: films/paper rolls
Substrate dimension:	ExactaCoat: 30 x 30 cm Versicoat: rolls up to 60 cm width
Technologies available	Ultrasonic spray coating
Deposition materials available	Various, upon consultation, including biopolymer-based coatings
Typical applications	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).

3.5. Nanoparticle deposition system (BLNano)

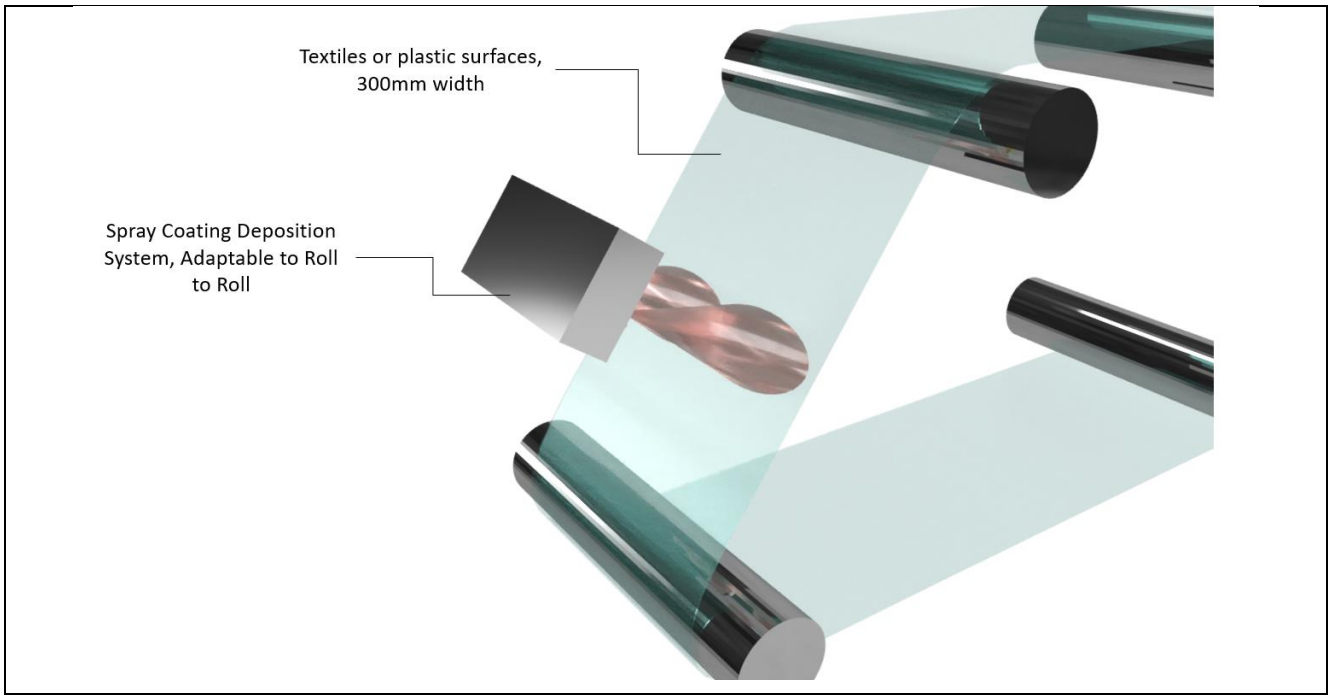


Figure 11: Picture and scheme of the nanoparticle deposition system

Table 11: Machine parameters of the nanoparticle deposition system

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

4. Cluster 3: Facilities for nano-structuring of surfaces

4.1. R2R UV Nanoimprint pilot line (JOANNEUM RESEARCH)

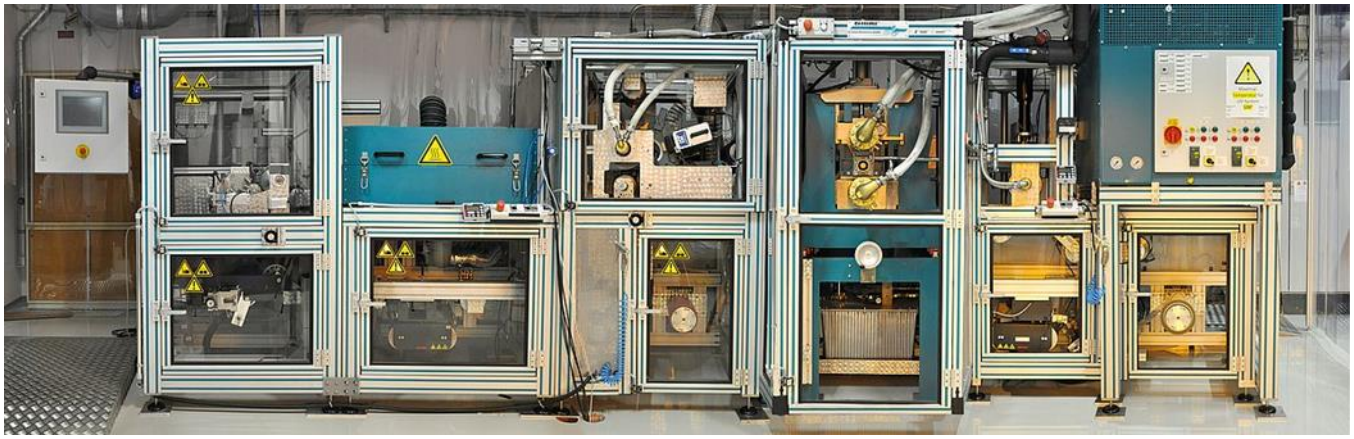


Figure 12 Roll-to-roll machine for UV nanoimprint lithography at JOA

Table 12: Machine parameters of the UV nanoimprint lithography

Machine name	Basecoater BC44
Machine type	Roll-to-Roll coating and UV nanoimprint lithography
Substrate types to be processed	Polymer films (including recycled PET and cellulose based film)
Substrate dimension:	Width of the roll upto 300 mm, Thickness range 20 – 250 µm
Technologies available	R2R rotogravure coating and printing, UV Nanoimprint lithography; web speed 0.5 to 30 m/min
Deposition materials available	UV curable resins (including biobased UV curable resins). NILcure®
Typical project fields	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.

4.2. Laser Structuring Facility (AUTH)

Figure 13: Picture of the laser structuring facility

Table 13: Machine parameters of the Laser Structuring Facility

Machine name	Laser Structuring Facility
Machine type	Scanning R2R Ultra-Short Pulse Laser System
Substrate types to be processed	Polymers, Metals, Paper
Substrate dimension:	300 mm wide rolls, Installed in R2R Pilot-Line, A4
Technologies available	Picosecond Laser, First & Second Harmonic (1064 nm and 532 nm)
Deposition materials available	
Typical applications	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

4.3. Nano-Imprint-Lithography test facilities (Coatema)

Figure 14: Picture of the NIL test facility

Table 14: Machine parameters of the NIL test facility

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

4.4. Roll-to-roll plasma etching (Fraunhofer FEP)

For details of the equipment please refer to section 1.

4.5. Surface structuring of lacquered layers (Fraunhofer FEP)

For details of the equipment please refer to section 3.

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

5.1. 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

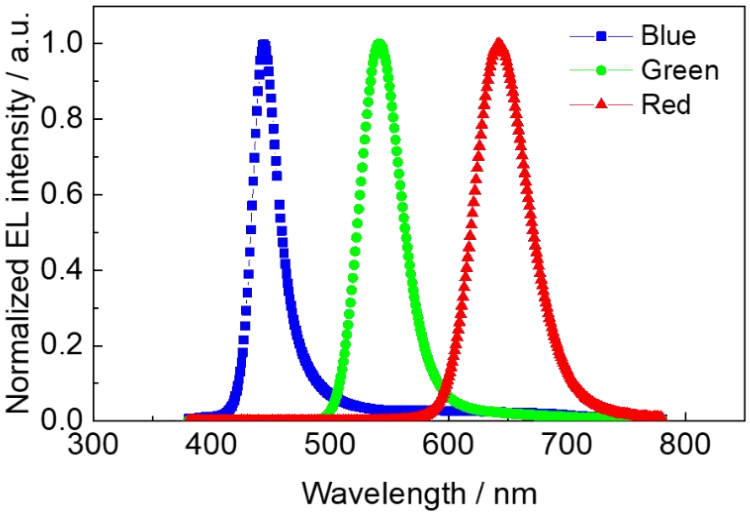
Machine name	Printed electronics line
Machine type	Roll-2-Roll printed electronics pilot Line
Substrate types to be processed	Polymer films
Substrate dimension:	300 mm coating width
Technologies available	inkjet printing; slot-die coating; flexo-printing, screen and gravure printing, Laser structuring,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

5.2. OVPD machine (AUTH)

Table 16: Machine parameters of OPVD machine

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

5.3. Sheet-2-Sheet printed electronics line (Fraunhofer IAP)



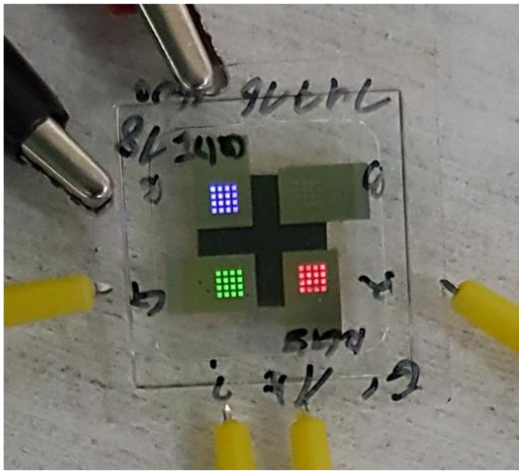


Figure 16 Picture of the clean room with the organic electronic pilot line in the back on the left hand side (upper picture) and results from the inkjet printed QD-LEDs processed in the organic electronic pilot line

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

Machine name	Printed electronics pilot line
Machine type	Sheet-2-Sheet
Substrate types to be processed	Polymer films
Substrate dimension:	150 x 150 mm
Technologies available	ALD encapsulation, Inkjet printing, slot die coating, vacuum evaporation, encapsulation of organic electronic (OE) devices
Deposition materials available	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
Typical applications	Printed electronics

6. Conclusions

The deliverable summarizes the most important technical information of all the machines which are available within the framework of FlexFunction2Sustain OITB.

Each machine is subject of a separate chapter. In each case, a picture is given together with a table of the most important information. This information will be available to the public via the Flexfunction2Sustain web page.

7. Degree of progress

Degree of fulfilment is 100%.

8. Dissemination level

Public.