



# Coatema research & development projects

## Overview

Introduction

Current  
R&D projects

Former  
R&D projects

Summary

Introduction

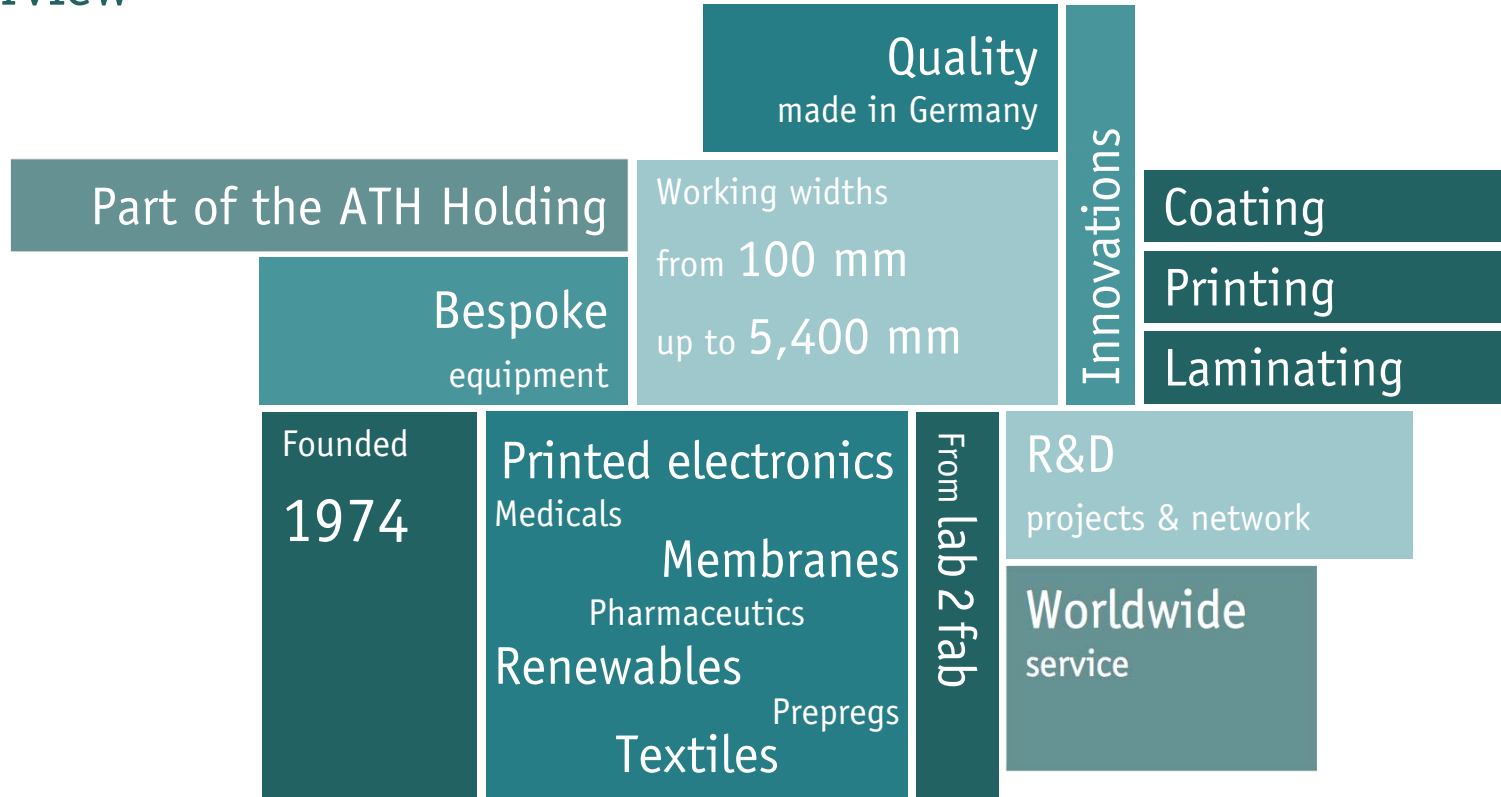
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## Overview



## Group of companies

**ATH** ALTONAER  
TECHNOLOGIE  
HOLDING



- ✓ Founded 1903
- ✓ Approx. 200 employees
- ✓ Located in Hamburg

**DRYTEC**

- ✓ Founded 1995
- ✓ Approx. 50 employees
- ✓ Located in Norderstedt



- ✓ Founded 1974
- ✓ Approx. 50 employees
- ✓ Located in Dormagen



- ✓ Founded 1919
- ✓ Approx. 140 employees
- ✓ Located in Hamburg

## Vision – from lab 2 fab



Lab



Pilot



Production

Coatema equipment platform strategy for lab 2 fab

## Our R&D mission

- ✓ **The exploration part of R&D services**
  - ✓ Exploration of new technologies which can or could have an impact on Coatema
- ✓ **Demonstration of R&D results**
  - ✓ Product driven engineering solutions
- ✓ **Development & engineering of novel equipment**
  - ✓ Optimizing process regimes to eliminate bottle-necks in new or existing technologies
- ✓ **Interdisciplinary Symposia for industry & training**
  - ✓ Mid-term branding of Coatema
- ✓ **Consultancy & Equipment optimization**
  - ✓ Cost reduction & added value for endusers

## Product portfolio

### Process development

- ✓ Feasibility study
- ✓ Ink – process study
- ✓ Process analysis
- ✓ Proof of concept
- ✓ Small scale prototype

### Test production

- ✓ Prototyping
- ✓ Near to market testing
- ✓ TRL evaluation
- ✓ Training of staff

### Education

- ✓ Coatema conference
- ✓ Training of customers
- ✓ Education of students

### After sales service and ramp up of processes

- ✓ of Coatema units

### Development of custom made design for equipment

- ✓ Prototyping
- ✓ Proof of concept

### Funded research projects

- ✓ German funded
- ✓ Horizon 2020
- ✓ Global 2+2 projects
- ✓ B2B projects



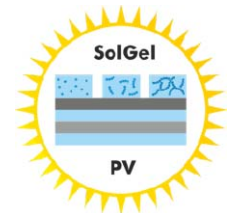
## R&D projects overview 2020





Oled Solar



E-Nanoprint Pro



## R&D projects 2020

Bundesministerium für Wirtschaft und Energie  
FKZ: ZF4099702BL6  
FKZ: TF4018750BL6c

**PowderSizing:** Process chain for powder laminated **glass fiber** enhanced compounds. 3 years, 0.8 M€



**Coatema:** Developing coating rollers for improved surface coverage of fibers.




Bundesministerium für Wirtschaft und Energie  
FKZ: 03ET1470D

**FLEX-G:** Flexible **roof and facade elements**. 3 years, 2.4 M€



**Coatema:** Transferring the lab process to a R2R process and upscaling.

GA No. 761000

**Greensense:** Sustainable **paper-based** printed electronics and **biosensing platform**. 4 years, 8.0 M€



**Coatema:** Engineering of machinery and process development for Nano Cellulose.

GA No. 0800645

**Supersmart:** Scale-Up of Printed Electronics Recyclable SMART materials. 3 years, 5.0 M€



**Coatema:** Subtask partner for machinery development.

Bundesministerium für Wirtschaft und Energie  
FKZ: 03XP0129C

**SOLID:** Innovative **solid state batteries** with Sol-Gel, Li anodes and 3D structuring. 3 years, 2.1 M€



**Coatema:** Upscaling of lab processes for Sol-Gel materials and integration of new concepts.

GA No. 820789

**OLEDsolar:** Scale-Up of optoelectronics to production. 3 years, 7.8 M€



**Coatema:** Improving registration accuracy in R2R processes.

ZF4099704SL8

**EL-FIB:** Development of **electroluminescent tapestry**. 2 years, 1.2 M€

**Coatema:** Upscaling of printing and coating processes, **intermittent slot die**.

Bundesministerium für Bildung und Forschung  
FKZ: 02WCL1019C

**PEPcat:** Plasmonically Enhanced Photocatalysis for Waste-Water Treatment. 3 years, 3.0 M€

**Coatema:** Novel Easycoater Design for S&R R2P NIL; Enhancing the system accuracy to sub digit micrometer range.

## R&D projects 2020

### E-Nanoprint Pro



Rocket-Re: -I-XXX

**E-Nanoprint Pro:** Nanowire printing Process development for Health-medical applications.

**Coatema:** Integration E-Nano printing head in R2R process equipment.



EFRE-0801555

**Effilayers:** Flexible **organic solar-cells.**  
3 years, 1.5 M€

**Coatema:** Process development and equipment for R2R Process.



GA No. 862442

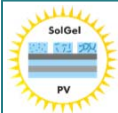
**RealNano:** In-line and Real-time Nano-characterization technologies for flexible OE. 3 years, 4.9 M€

**Coatema:** Integration of characterization tools in pilot to production line.



GA No. 862156

**FF2S: Upgrade** of various **pilot lines** and connection to an open-innovation test bed (**OITB**). 4 years, 16 M€  
**Coatema:** Upgrade of the R&D centre and of two external pilot lines; development of a R2R ALD system; execution of user and pilot cases .



Bundesministerium  
für Bildung  
und Forschung

FKZ: 0324151C

**SOLGEL-PV:** multipurpose **Sol-Gel films** for **PV.**

3 years, 2.0 Mio.€

**Coatema:** Upscaling of **R2R Nano-Imprint process** toward **Click&Coat®**

## Our USP – strength & expertise

- ✓ Multifunctional team of 10 including researchers, engineers and application experts
- ✓ Successful AiF, BMWiF, BMWi and European projects since 2002
- ✓ Global and strong European Network in different technology areas
- ✓ Interdisciplinary networking for innovative coating, printing and laminating solutions
- ✓ Europes biggest and most versatile R&D centre
- ✓ Engaged in currently more than 10 R&D projects
- ✓ Early market entry & know-how build up for start up companies

## R&D customers



## Our R&D process – R&D strategy

### Step 1

- ✓ Open minded networking with partners (listening & analysis)
- ✓ Identify high value products (product growth rates & margins)
- ✓ Innovative concept for R2R process application (first results)
- ✓ Looking for enduser with intention to start production

### Step 2

- ✓ Building of consortium and finalizing ideas
- ✓ Specify funding opportunities
- ✓ Proposal preparation and submission
- ✓ Evaluation & negotiation
  - Kick-Off-Meeting

## Use of the Coatema research & development centre



### Technologies

Coating, printing, laminating, imprinting, pretreatment, drying, curing, cross linking, cutting

### Number of units available

10 – 12 units on 1 200 sqm

### Sheet-to-Sheet – S2S

up to 300 mm x 500 mm

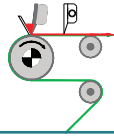
### Roll-to-Roll – R2R

up to 500 mm width

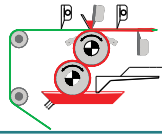
### Operation speed

0.1 to 100 m/min

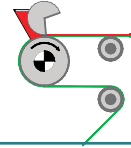
## Coating systems



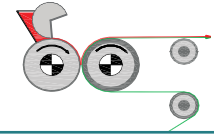
Knife system



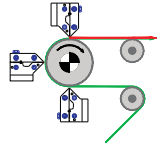
Double side system



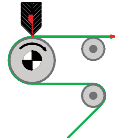
Commabar system



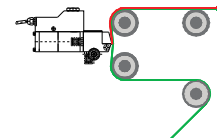
Reverse commabar system



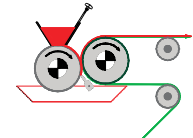
Slot die system



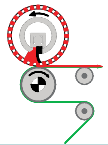
Curtain coating system



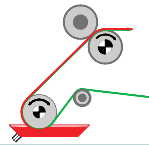
Hotmelt slot die system



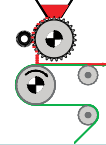
Case knife system



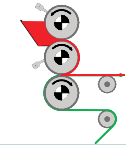
Rotary screen system



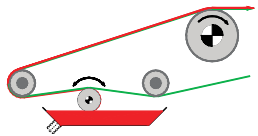
Dipping system (Fouard)



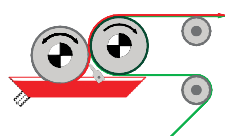
Powder scattering system



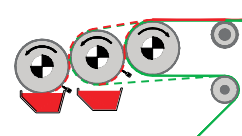
Reverse roll system



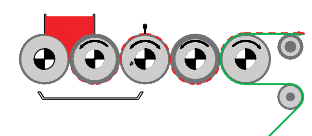
Micro roller system



2 Roller system



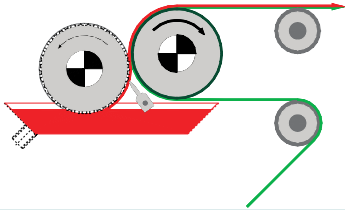
3 Roller combi system



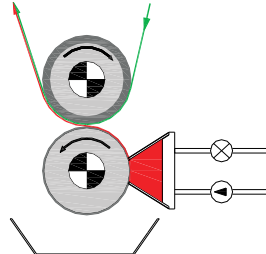
5 Roller system



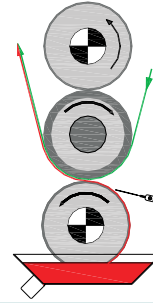
## Printing systems



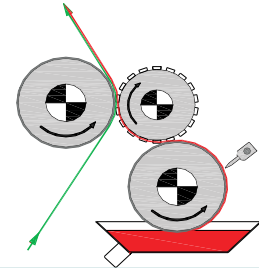
Engraved roller system



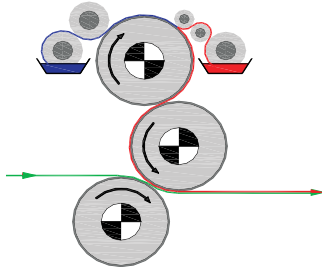
Gravure roller system



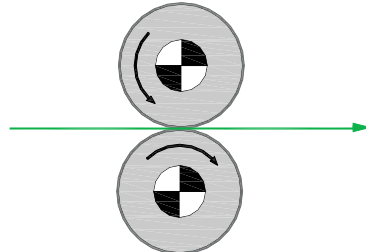
Gravure indirect system



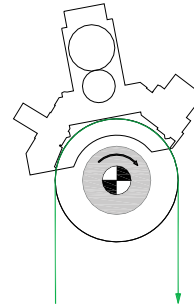
Flexography system



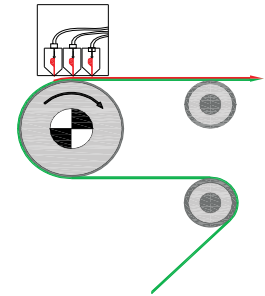
Offset lithography system



Hot embossing system

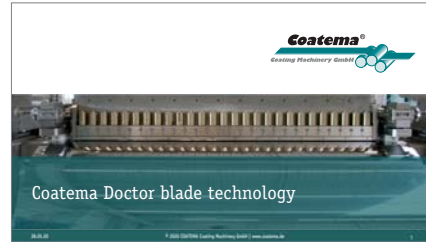


Nanoimprint system



Inkjet system

## Overview of technical presentations



## Our work in associations – global networking



Board Member:  
OE-A

Advisory Board:  
Fraunhofer ITA

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current

## Process and equipment for printed electronics

EffiLayers

EI-FIB

ELECTROLUMINESCENCE  
for FLAGS, INTERIOR and  
BANNERS

### R2R process optimization of organic photovoltaic cells

✓ 09/2019 – 08/2022    ✓ 1.5 M€ total budget

✓ 4 German partners

✓ Follow on project of Flexlas & PhotonFlex

✓ Flexible organic solarcells (OPVs)

✓ Process development

✓ Laser drying and patterning

✓ Equipment engineering

### Electroluminescent textiles for interior and exterior decorative and advertising applications

✓ 10/2018 – 09/2020    ✓ 1.6 M€ total budget

✓ 2 Belgian, 4 German partners

✓ Illuminating wallpaper

✓ Process upscaling for production of EL textiles

Leitmarkt  
Agentur.NRW

Die Landesregierung  
Nordrhein-Westfalen



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2014

EFRE-080155

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and Employment



Supported by:



Federal Ministry  
for Economic Affairs  
and Energy

## Printed electronics & fabric functionalization



### Sustainable paper-based printed electronics and biosensing platform

- ✓ 01/2018 – 12/2021
- ✓ 8.0 M€ total budget
- ✓ 11 EU partners + 2 non EU
- ✓ Printed electronics on paper
- ✓ Nano cellulose instead of „normal“ paper
- ✓ Sensors for „drug-of-abuse“ analysis
- ✓ Recyclable, ultra-low power consumption, low cost, environmental friendly biosensing platform
- ✓ <https://www.greensense-project.eu>

### R2R technology for producing ECD with tunable g-values

- ✓ 06/2017 – 05/2020
- ✓ 2.4 M€ total budget
- ✓ 11 German partners
- ✓ Follow up on EELICON
- ✓ R2R production of ECD on EFTE
- ✓ R2R production of OPV
- ✓ Improved lamination
- ✓ ECD for membrane roofs



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 761000.



Bundesministerium  
für Wirtschaft  
und Energie

FKZ: 03ET1470D

## Nano-imprint



PEPcat

Innovative solid state batteries with Sol-Gel,  
Li anodes and 3D structuring

10/2017 – 09/2020 | 2.1 Mio.€ total budget

- ✓ 6 German partners
- ✓ Innovative cell concepts
- ✓ All solid state batteries
- ✓ Lithium metal anode
- ✓ Sol-Gel cathode and current collectors
- ✓ Upscaling of lab processes

PEPcat: Plasmonically enhanced photocatalysis for  
wastewater treatment

06/2019 – 05/2021 | 3.0 Mio € total budget

- ✓ 5 German partners
- ✓ Novel advanced oxidation process with reduced energy consumption for wastewater treatment
- ✓ Scale-up photocatalytic nanostructures for industrial production
- ✓ Enhancing machinery accuracy to single digit micrometer range
- ✓ [www.pepcat.de](http://www.pepcat.de)

## Printed electronics & process control



### Scale-Up of Printed Electronics Raw materials on of flexible organic solar cells

✓ 01/2018 – 12/2020 ✓ 5.0 M€ total budget

✓ 7 EU partners

✓ Products and services for circular economy

✓ Scale-up key materials for organic and printed electronics

✓ Enhance EU competitiveness in organic and flexible electronics

✓ <https://supersmart-project.eu/>



Oled Solar®

### Advanced production for opto-electronics Towards industry 4.0

✓ 09/2018 – 08/2021 ✓ 7.8 M€ total budget

✓ 18 European partners

✓ Inline measurement and registration for OLED and Solar processes on R2R

✓ In the stage of project planning and clarification of needs

✓ <https://oledsolarproject.eu/>



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 696076.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 820789.



## Sustainable production technology



In-line and real-time digital nano-characterization for flexible organic electronics

✓ 03/2020 – 02/2023    ✓ 4.9 M€ total budget

✓ 9 European partners

✓ Development of rapid characterization methodologies and integration in pilot-to-production lines

✓ Digital Intelligence to manufacturing

✓ <http://www.realnano-project.eu/>



Creation of an open innovation test bed for future-oriented and sustainable production technology

✓ 04/2020 – 04/2024    ✓ 16 M€ total budget

✓ 21 European partners

✓ Validate and demonstrate the outstanding performance of novel nano-functionalized plastic, paper and membrane surfaces

✓ Upgrade existing “lab-to-fab” facilities and connect them to a unique OITB (TRL4 → TRL7)

✓ <https://flexfunction2sustain.eu/>



This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 862442



This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 862156

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FORMER

## (Opto-)electronic devices



### Bringing flexible organic electronics to Pilot innovation scale

- ✓ 01/2016 – 12/2018
- ✓ 14.0 M€ total budget
- ✓ 14 EU partners
- ✓ Flexible organic light-emitting diodes (OLEDs)
- ✓ Open access Pilot line
- ✓ Intermittent coating with low viscous inks
- ✓ [www.pi-scale.eu](http://www.pi-scale.eu)

### Development of slotdie equipment for perovskite solar cells

- ✓ 07/2017 – 06/2019
- ✓ 0.8 M€ total budget
- ✓ 3 EU partners
- ✓ Ultra fast intermittent coating
- ✓ Piezo based technology
- ✓ Perovskite photovoltaics devices
- ✓ Improved material usage & yield
- ✓ <http://rocket-innovations.eu/laufende-innovationsprojekte/i07-icoat/>



PHOTONICS PUBLIC PRIVATE PARTNERSHIP  
GA No. 688093



Rocket-I-007

Europäische Union  
Europese Unie

## From 2D materials and 3D coating on fibre materials



### Synthesis, properties & application of 2D-materials

- ✓ 04/2016 – 03/2019
- ✓ 2.1 M€ total budget
- ✓ 6 German partners
- ✓ Synthesis of 2-D Materials such as Graphene and MoS<sub>2</sub>
- ✓ Trials & design study for deposition & transfer
- ✓ R2R and R2P processes

### Process chain of powder-coated glass-fiber reinforced compounds

- ✓ 12/2016 – 11/2019
- ✓ 0.8 M€ total budget
- ✓ 2 German partners
- ✓ Homogeneous organic composites
- ✓ Fully coated fibers
- ✓ Less production steps
- ✓ Electrostatic rollers



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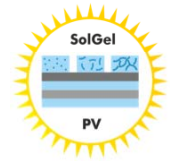
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EFRE-0800148



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für Wirtschaft  
und Energie  
FKZ: ZF4099702BL6  
FKZ: TF4018750BL6c

## Solar cells



### Production of flexible organic solar cells

- ✓ 06/2016 – 06/2019
- ✓ 1.3 M€ total budget
- ✓ 5 German partners
- ✓ Follow on project of Flexlas
- ✓ Flexible organic solarcells (OPVs)
- ✓ Process development
- ✓ Laser drying and patterning
- ✓ Equipment engineering



EFRE-0800069

### Multipurpose Sol-Gel films for Photovoltaic

- ✓ 04/2017 – 3/2020
- ✓ 2.0 M€ total budget
- ✓ 6 German partners
- ✓ Sol-Gel materials as adhesive
- ✓ Sol-Gel as passivation layer
- ✓ Sol-Gel materials as Mie resonator
- ✓ Upscaling of nanoimprint



## (Opto-)electronic devices



### Enhanced Energy Efficiency and Comfort by Smart Light Transmittance Control

✓ 01/2014 – 06/2017

✓ 13 EU partners

✓ Follow-up project of Innoshade

✓ Lightweight electrochromic devices

✓ Click&Coat technology

✓ Scaling & automation

✓ Demonstration of pilot line production

✓ Market entry

✓ <https://www.eelicon.eu/>



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 604204.



### Development of machines, tools and processes for OE nanomaterials

✓ 01/2013 – 12/2016

✓ 7.9 M€ total budget

✓ 17 EU partners

✓ Smart nanomaterials & technologies

✓ Pilot line

✓ Upscaling of R2R process

✓ Production of OE devices

✓ [www.smartonics.eu](http://www.smartonics.eu)



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 310229.

## Electronic devices



### Innovative Switchable Shading Appliances based on Nanomaterials and Hybrid Electrochromic Device Configurations

- ✓ 09/2008 – 08/2012
- ✓ 10 M€ total budget
- ✓ 19 EU partners
- ✓ Large scale, cost effective and light weight, high trough put
- ✓ In-situ-polymerization
- ✓ Prototype & demonstrator
- ✓ Concept & start of Pilot line

### High-speed laser process for the production of fully integrated flexible solar cells

- ✓ 08/2011 – 10/2014
- ✓ 5 partners (Ziel2.NRW)
- ✓ Optics
- ✓ OPV development
- ✓ Laser patterning, structuring welding
- ✓ Demonstration



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 200431.

**Ziel2.NRW**

Regionale Wettbewerbsfähigkeit und Beschäftigung



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European Regional  
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## Organic electronics & thin film batteries



### Contamination and Defect Control for Increased Yield for Large Scale R2R Production of OPV and OLE

- ✓ 05/2012 – 04/2015
- ✓ 10 M€ total budget
- ✓ 17 EU partners
- ✓ Detection & inspection
- ✓ Cleaning
- ✓ Repair
- ✓ Integration
- ✓ Best practice procedures

## ProLiBat

### ProLiBat – Design of a continuous fabrication structure for the production of Li-Ion-Batteries

- ✓ 08/2011 – 02/2014
- ✓ 7 partners
- ✓ Pilot line for Li-Batteries
- ✓ Concept for standardization
- ✓ Production specifications
- ✓ Study for production
- ✓ Process for batteries



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 281027.

## Ziel2.NRW

Regionale Wettbewerbsfähigkeit und Beschäftigung



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## Novel applications



### ML2 – MultiLayer MicroLab

- ✓ 09/2012 – 08/2016
- ✓ 12 EU partners
- ✓ Click&Coat™ Technology
- ✓ Imprint Technology
- ✓ Transfer Processes e.g. vacuum to wet R2R
- ✓ R2R-manufacturing platform
- ✓ Micro-Nano-Bio-Systems
- ✓ [www.ml2.eu](http://www.ml2.eu)



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 318088.



### Innovation for Digital Fabrication

- ✓ 03/2012 – 02/2014
- ✓ 21 EU partners
- ✓ Networking Project
- ✓ Roadmap for Digital Fabrication
- ✓ Status & evaluation of digital 3D-Manufacturing, e.g. organic Electronic



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 290557.

## Novel combinations

**3D** LIGHT  
TRANS

**fabrigen**

Large scale manufacturing technology for high-performance lightweight 3D-multifunctional composites

✓ 04/2011 – 03/2015

✓ 18 EU partners

✓ Automotive application

✓ 3D-textile & novel efficient production

✓ Complete manufacturing chain

✓ Demonstration of Prototype

✓ Reduced process time & cost

✓ Qualification of principle

✓ [www.3d-lighttrans.com](http://www.3d-lighttrans.com)



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 263223.

Fabric Structures for Solar power generation

✓ 11/2011 – 04/2014

✓ 8 EU partners

✓ Tensile Membrane material that incorporates PV modules

✓ Qualification of principle

✓ Demonstration of Prototype, e.g. off-Grid local power



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 286605.

## Inline monitoring & thin film characterisation



### Thin Film Measurements on organic photovoltaics layers

- ✓ 11/2012 – 10/2014
- ✓ 1.5 M€ total budget
- ✓ 8 EU partners
- ✓ Integration of in situ-metrology in manufacturing line at Coatema
- ✓ Hyperspectral Imaging
- ✓ Spectroscopic ellipsometry
- ✓ Demonstration of prototype
- ✓ Qualification of principle



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 315665.

### Registration Accuracy, High accuracy Registration control for roll2roll manufactured printed electronic

- ✓ 11/2013 – 10/2014
- ✓ AIF-Project
- ✓ 3 EU partner + 1 partner from Japan
- ✓ Integration of novel Printing Units in Production Line
- ✓ High registration accuracy
- ✓ Control software
- ✓ CCD-camera
- ✓ Demonstration of prototype



FKZ: KU3190401RR3

## Inline analysis

### Fluorescence detection

#### Inline evaluation of transparent foil coating

- ✓ 03/2015 – 08/2017
- ✓ 125.000 € total budget
- ✓ 2 German partners
- ✓ Detection of organic dyes
- ✓ Small amounts of dye
- ✓ Quartz light guiding
- ✓ Stimulation via UV-LED
- ✓ Detection with photodiode

And many  
more...



FKZ: KA3190402ZG4

## Summary

Introduction

Current  
R&D projects

Former  
R&D projects

Summary

Summary

### Coatema is...

- ✓ A valuable partner for novel R2R-processes
- ✓ An expert in transferring processes to pilot and production lines
- ✓ Innovation leader in novel equipment
- ✓ Coordinator or partner in funded projects since 2002
- ✓ Member of the ATH Holding, a group of technology leading companies in coating, printing and laminating

Do not hesitate to contact us!



Anything missing?

Let us know and we will make it happen!

Our R&D centre is worldwide the most versatile centre for coating, printing and laminating.

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Thank you



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