FUNDACIÓN PRODINTEC

FÁBRICA DE FUTURO

ROLL-TO-ROLL PLATFORM FOR THE DEVELOPMENT OF FUNCTIONAL FLEXIBLE PRODUCTS

14th AM Platform Meeting

Brussels June 2014

LIGHT ROLLS: ROLL-TO-ROLL PILOT LINE

- A high throughput production platform for the manufacture of **functional flexible products** in key industrial sectors (lighting, biochemical sensors, photovoltaic, smart textile, displays, etc)
- Achieved after 4 years (2008-2012) of Research and Development work. Budget consumed 5.5 M€ (FP7; designated as success case by EC)
- **KET´s involved:** i) Advanced Manufacturing, ii) Photonics, iii) Information and Communication Technologies and iv) nanotechnology
- **Societal challenges addressed:**
  - Health: via the development of novel devices for diagnostics and drug delivery
  - Food security: via the design and production of innovative sensors for food packaging
  - Clean and efficient energy: via the design and production of green lighting systems based in LED and OLED technology
  - Innovative and secure societies: via new sensors integrated in micro-devices
  - Well-being: via the development of innovative products for the creative industry

Design LED Technology Evolution and Roadmap

Evolution of the technology platform: Existing and Emerging products

Illuminated backlights and capacitive (touch) switches – now on market

Professional lighting tiles
E.g. Shelf tiles and signage

Consumer and Professional Luminaire launch

today

Medical devices
LCD TV backlight unit

Solar concentrators, touch light panels, water treatment, bio-diesel, light chimney

Passive Active Capacitive Switch

2004 → 2007
Small area
Capacitive touch

Hybrid BLU

2008- 2010
Prototype 40" white backlight unit
Prototype "bulbless" consumer lighting

Light Tile

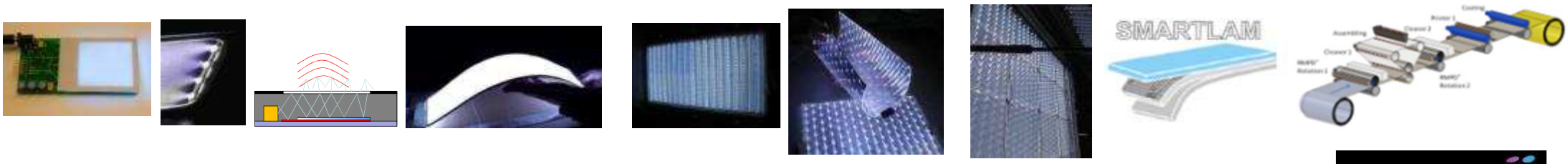
2011
Thin, efficient, low cost large-area illumination

LIGHTROLLS SMARTLAM

2012
Custom Beam Distribution
Modular Large Area Backlight
Improved durability, reliability, proven efficiency

Next Generation

2014+
Roll-to-roll lighting manufacturing process and Rapid prototyping chip-in-polymer



Technology Video http://vimeo.com/user10670777/review/40289113/52a785bebd

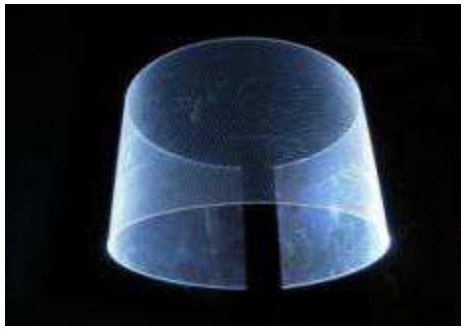
MARKET: INDUSTRIAL APPLICATIONS

SECTOR:

- *LIGHTING*
- *MEDICAL*
- *BIOTECHNOLOGY*
- *AUTOMOTIVE*
- *CONSUMER GOODS*

PRODUCTS:

- *LIGHTING SYSTEMS*
- *ADVERTISING PANELS*
- *SMART PACKAGING*
- *DISPLAYS, SMART TEXTILES……*



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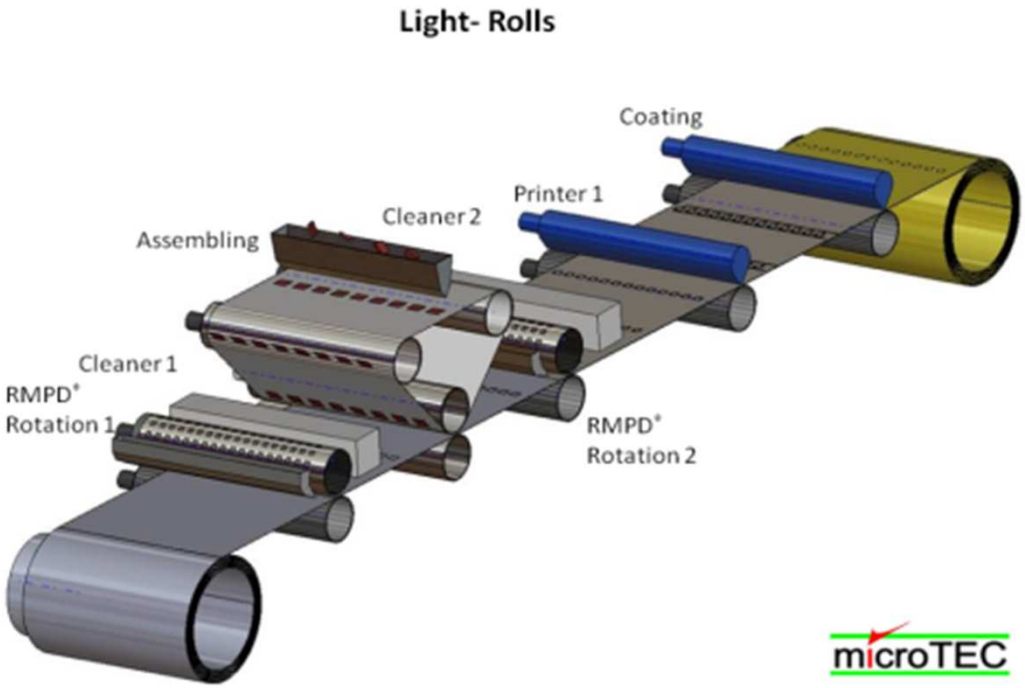
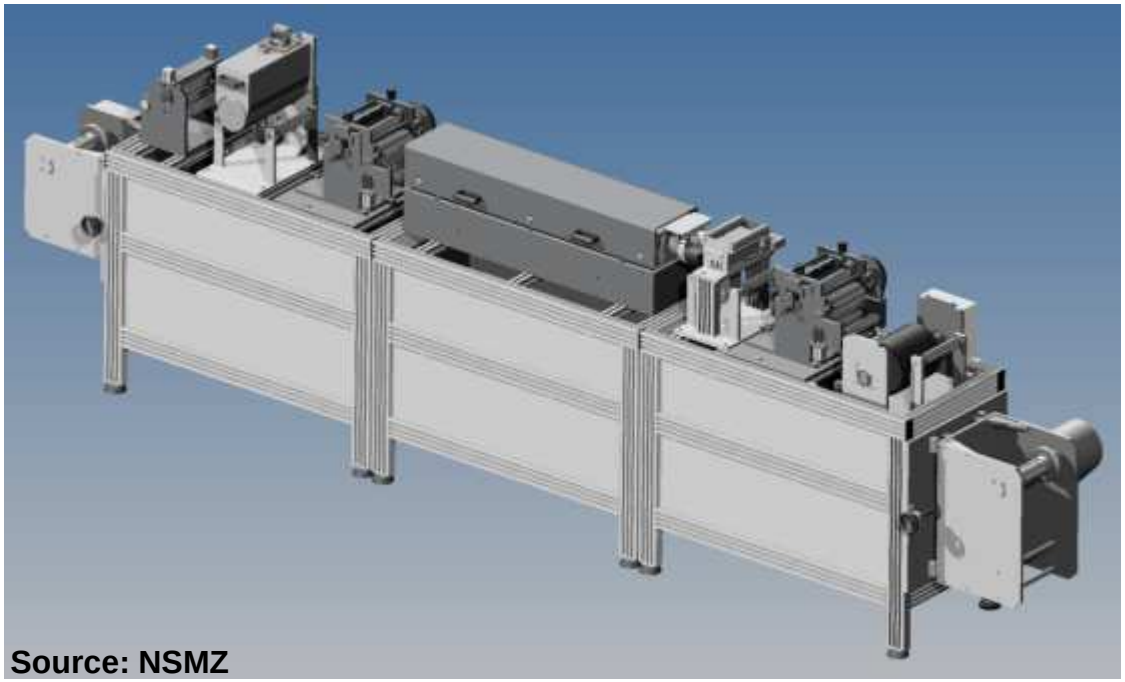
ROLL-TO-ROLL PILOT LINE

3 MAIN PRODUCTION MODULES:

- **RMPD® Rotation Unit**
- **SELF-ASSEMBLY UNIT**
- **PRINTING UNIT**

INTEGRATED IN ONE MANUFACTURING PLATFORM





Source: NSMZ

Design of Light-Rolls product

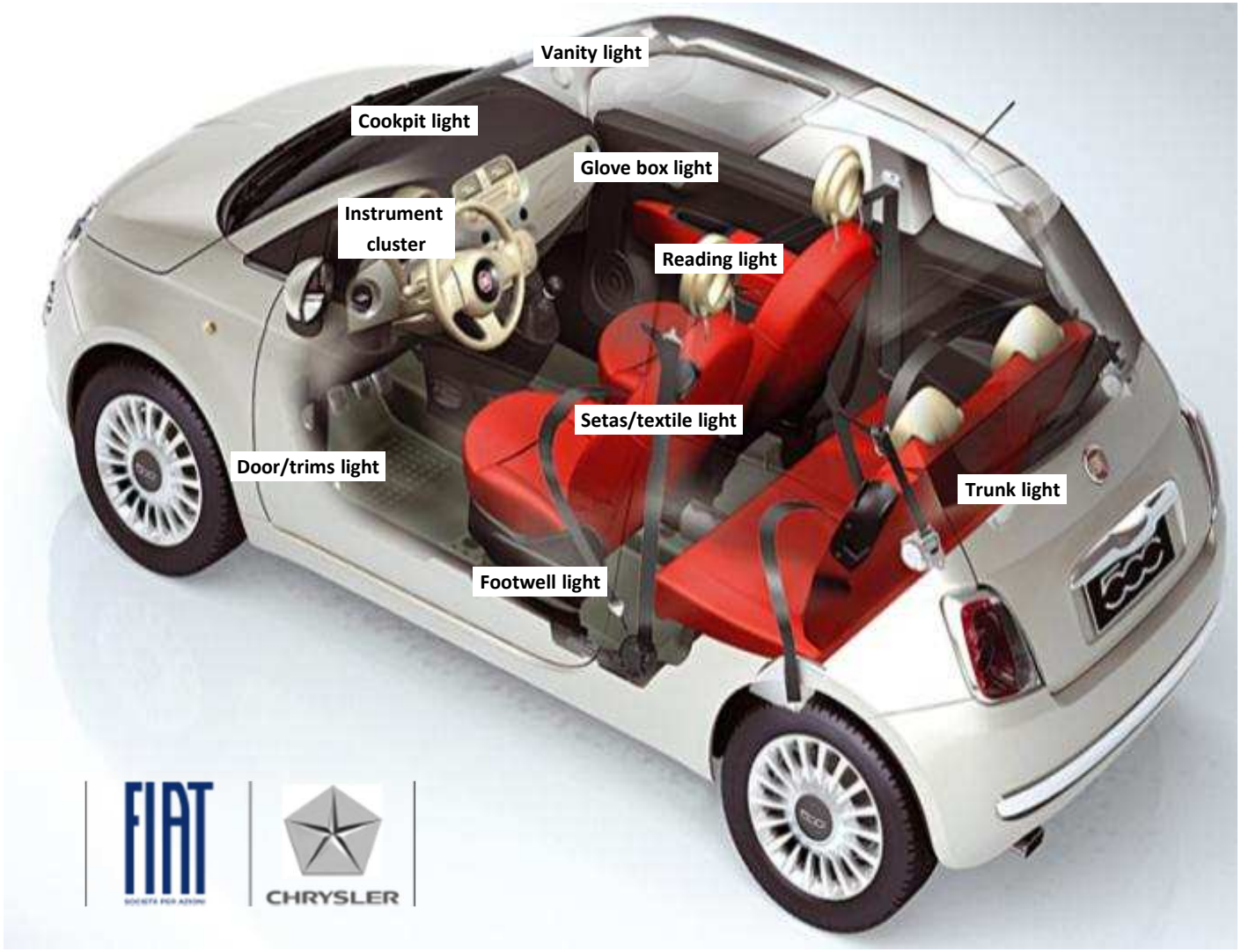
Conformable lighting/display systems

DRIVERS

- Integration and assembling of technologies
- Lightweight materials
- Improving perceived quality →conformal devices
- More than 100 spots interiors & exteriors
- 5% of the overall car costs;

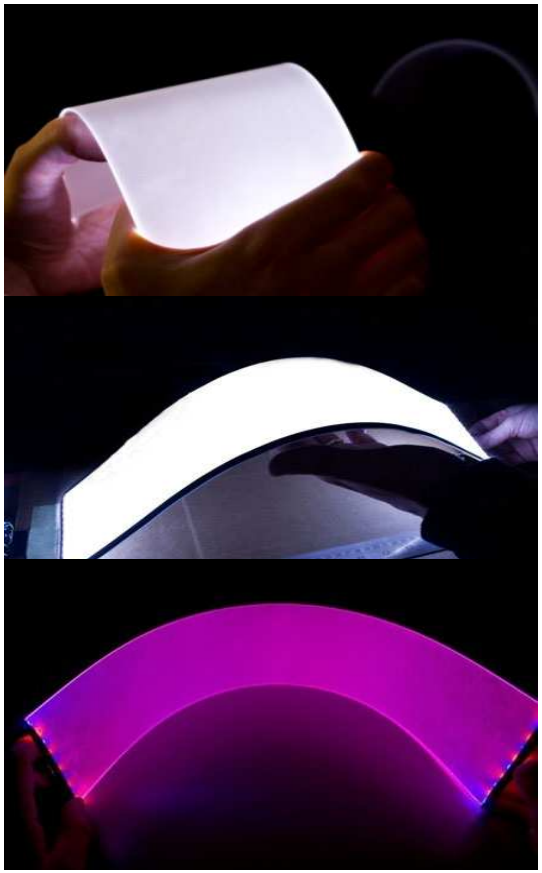
Applications

- Vanity light
- Glove box light
- Reading light
- Seat light
- Trunk light
- Doors light
- Instrument cluster
- Cookpit light
- Icons
- ….



PROJECT BEGINS

Light-Rolls



Courtesy of Designled Products Ltd.

EC funded project: LIGHT-ROLLS

Funded by European Community's Seventh Framework Programme under grant agreement n° CP-TP 228686

Research and development of modular based production units for the seamless, high throughput manufacture of micro-structured, polymer based components and microsystems.

Scientific objective: To realize structures in the micron range and integrate also dies to be assembled in high-speed and parallel by benefit of self assembling.

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LIGHT-ROLLS PILOT LINE – PROMOTERS

Light-Rolls

Norbert Schläfli Maschinen

Information Technology ocp

microTEC

designled technology driven

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Fraunhofer IPA

microelectronica

CRF CENTRO RICERCHE FIAT

XAAR®

9 participants
8 countries
Coordinator: PRODINTEC

Project duration:2009-12

Duration: 42 months

No. CP-TP 228686

SEVENTH FRAMEWORK PROGRAMME

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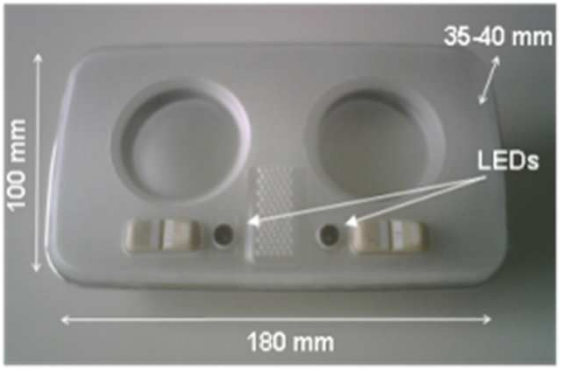
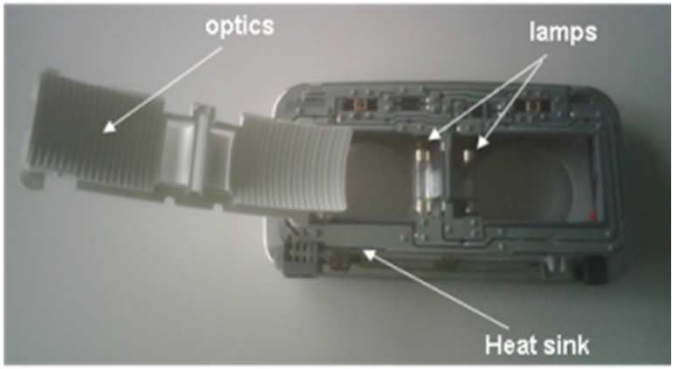
INTERIOR LIGHTING MODULE (LANCIA MUSA)

Light-Rolls

Current roof console of Lancia MUSA →
almost all FIAT vehicle assemble same module (standardization issue)

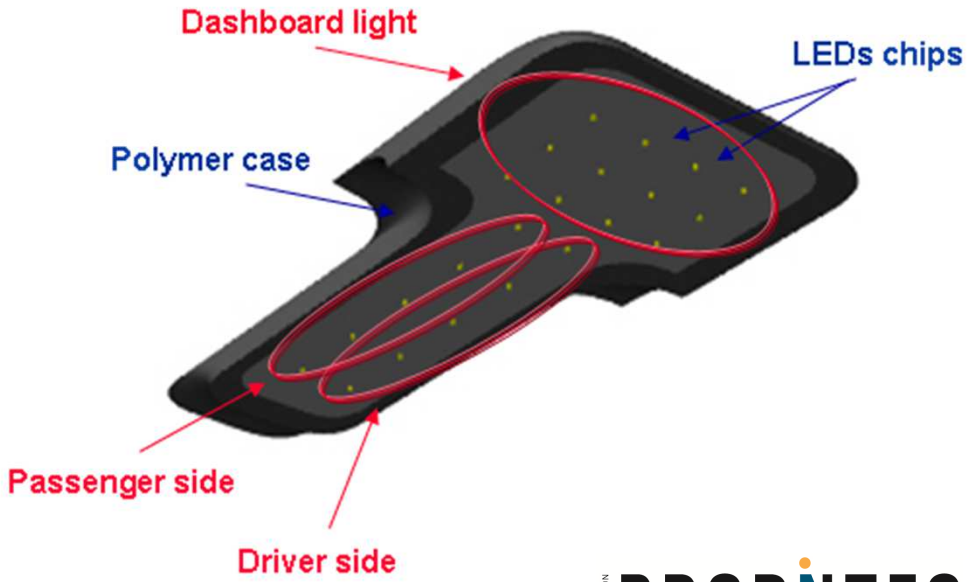




•Single light spots by LEDs

source: OLSA

•Diffusive panel for passenger/driver sides and dashboard light



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Microstructure production and encapsulation: RMPD®

- Component encapsulation
  - Layer thickness per pass 50 µm - 150 µm
- Microstructuring manufacturing
  - Selective curing of photosensible resins
  - Resolution down to 10 µm
- UV curing 365nm
- Resin dispenser and cleaning unit

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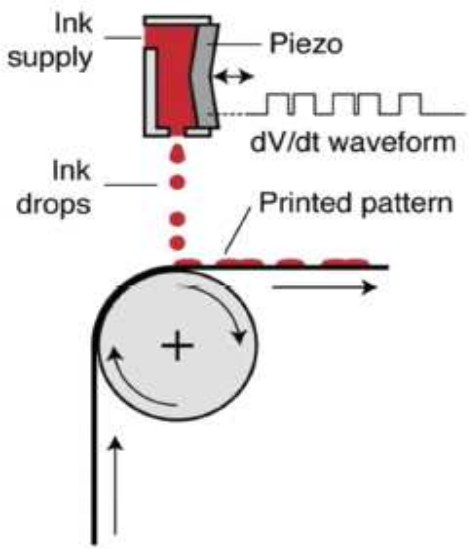
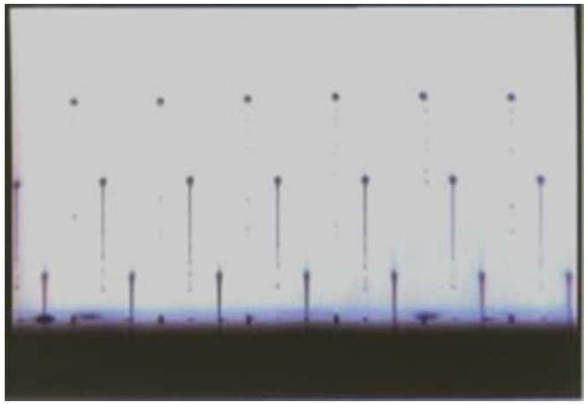
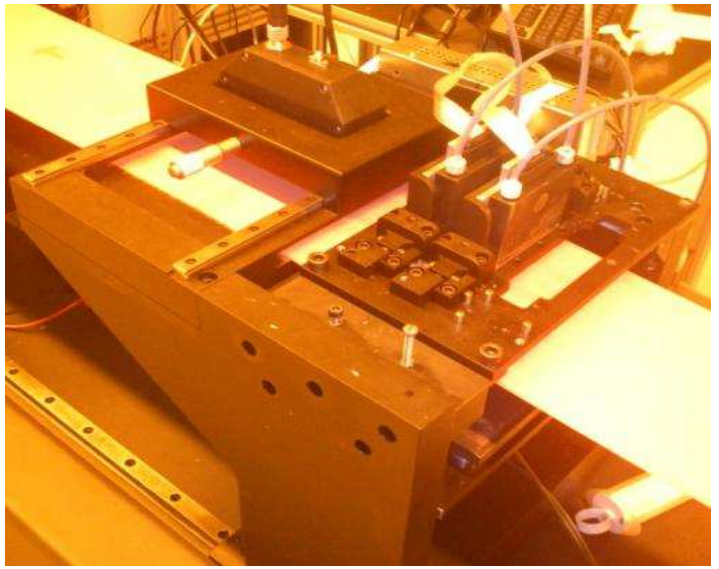
PRINTING MODULE: ink-jet





- Piezoelectric «drop-on-demand» Xaar
- High resolution (up to 600 dpi)
- Down to 100 µm line width and 6 µm thicknesses
- Waste-free
- Tool-free
- No contact with substrate
- High speed reachable (75 m/min)



DRUPA FAIR; COMMERCIAL EXPERIENCE

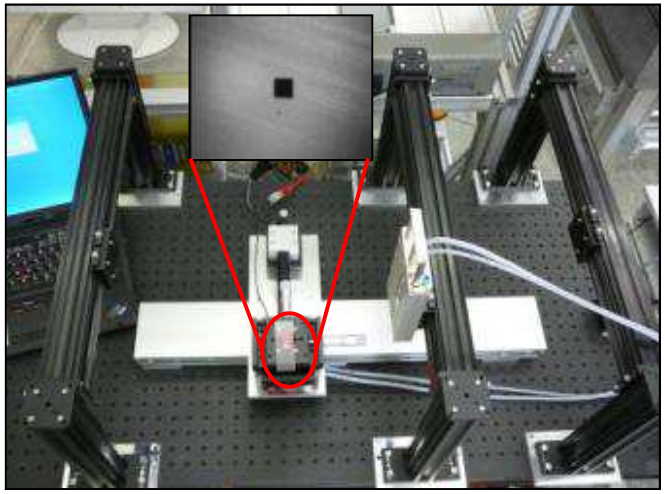
This fair is one of the most influencing events in the field of printing and only held every 4 years. On 2012, 314500 experts from more than 130 countries came to the fair in Düsseldorf.

1000 brochures of Light-Rolls vanished; 361 business cards collected; 180 visitors from VIP tour

SELF-ASSEMBLY MODULE

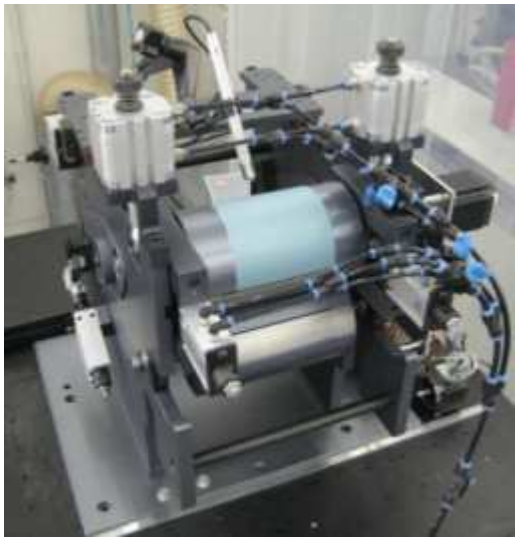
Light-Rolls

2010 – Testing Platform



- Linear Stages
  - Position Accuracy <10µm
  - Velocity > 500mm/s
- 3 Portal Frames
  - Functionalisation
  - Droplet deposition
  - Chip assembly
- Vision System

2011 – Offset Platform



- Basis system: laboratory offset-printing-system
- Offset-Cylinder with fixture for different foils/plates
- Impression cylinder for transferring of the LEDs to substrate

2012 – Self-Assembly Module

- Self-Assembly Module
  - Automated
  - Dispensing System
  - Magazin System
  - Roll-Off Process
  - Process Control integrated (PLC-Connector installed)

- Component size down to 0,35mm x 0,35mm
- Thickness 50 µm - 90 µm
- Precision in positioning on cylinder < 10 µm

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Sintering technologies: Photonic curing

Light-Rolls

- Curing / sintering of conductive inks with low thermal load on substrate
- Substrate temperature < 50ºC
- Adjustable pulse duration: 572 to 2044 µs
- Adjustable pulse energy: 200 to 1500 Joules
- Sintering area: 19 x 305 mm

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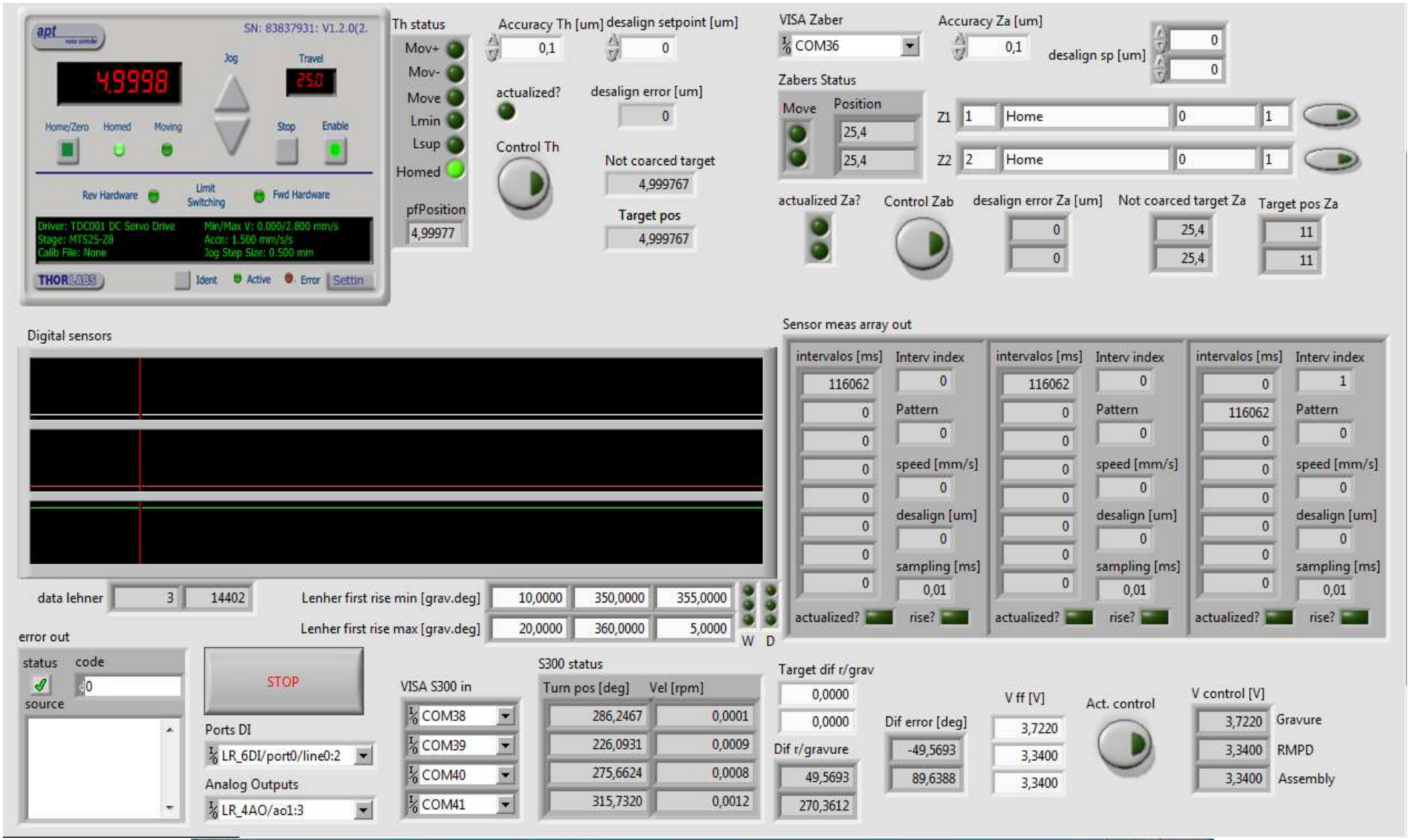
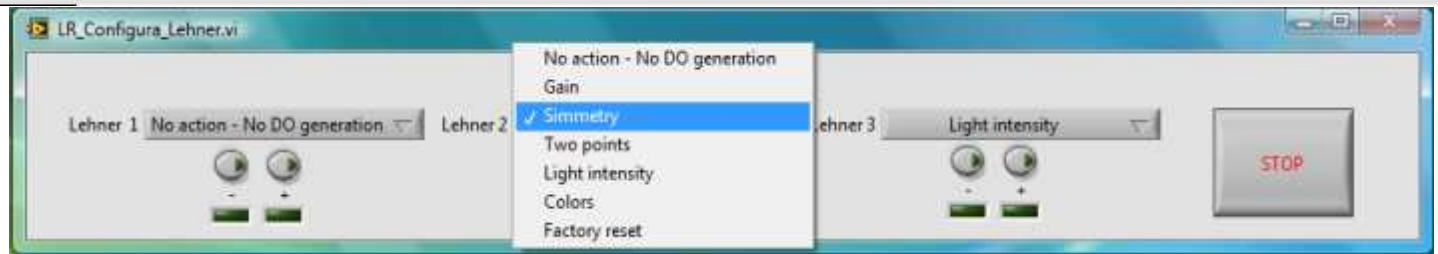
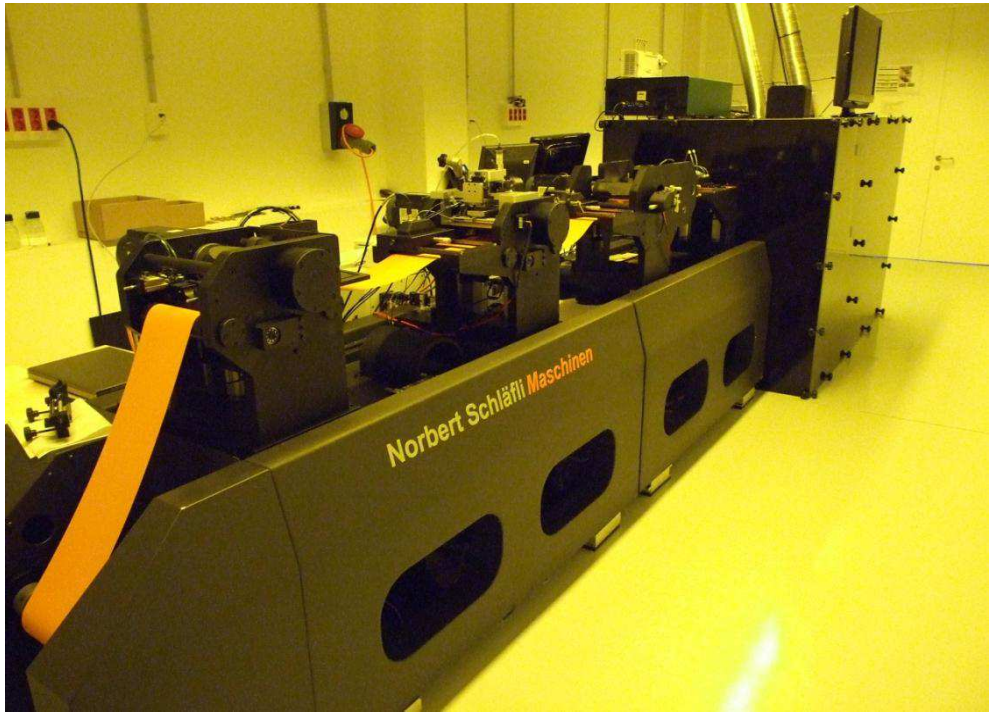
Configuration of Light-Rolls production

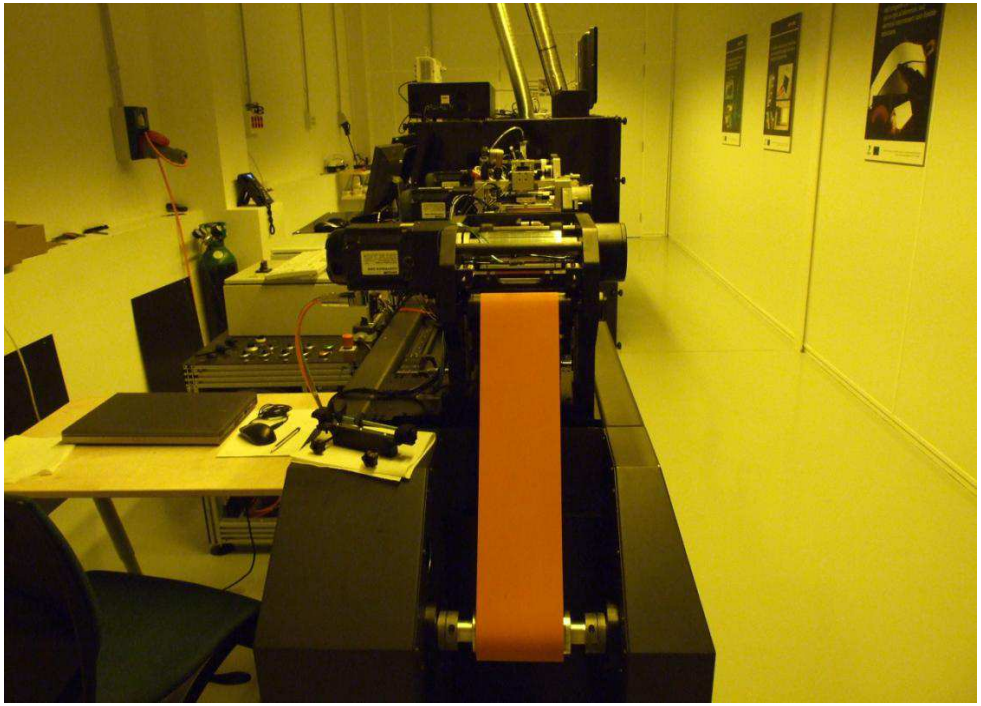




ROLL-TO-ROLL PILOT LINE

- A manufacturing platform already available at PRODINTEC (Spain) for the development and production of novel high added-value functional products.
- Line dimensions: 6 meters long + 4 Tons weight
- Open access to large companies, SME´s and RTD at global level
- Strong support to customers in design and manufacturing from product developers and researchers





Customers and business model

Our customers:

Industrial companies (large companies & SME´s), RTD´s, Universities and Industrial Associations interested in:

- Developing novel functional products based on flexible substrates which could finally produce at low cost using a unique high-throughput manufacturing technology
- Improving their already existing products by integrating new functionalities and the corresponding manufacturing process
- Implementing in their factories/laboratories innovative manufacturing technologies based on roll-to-roll manufacturing
- Testing new materials (for instance, functional inks, polymers for substrates, etc) to be used in roll-to-roll technologies
- Improving and modulating the existing manufacturing pilot line to high added value products or novel market niches via R&D collaborative projects

Business model:

- Business to Business approach (i.e. ad-hoc development projects with customers)
- Participation in R&D collaborative projects (for instance, using competitive operating grants)
- Consulting tasks on product development and roll-to-roll technologies
- Training and workshops on the technology and the associated product creation
- Subcontracting machine hours for carrying out preliminary tests or production of pre-series

ROLL-TO-ROLL PILOT LINE

MORE PRODUCTION MODULES:

- Gravure
- High-precision ink-jet
- Rotative screen-printing
- Self Assembly
- Robot Spider pick&place
- Photonic sintering
- Selective coating / encapsulation

INTEGRATED IN ONE MANUFACTURING PLATFORM

VALUE CHAIN IN PRINTING ELECTRONICS

Light-Rolls

Materials

- **Nano-based inks (e.g. silver nanowires, carbón nanotubes or graphene-based inks**
- **Novel flexible substrates with high optical properties, glass-based substrates**

Processes

- **Roll-to-roll technology**
- Sheet-to-sheet technology
- **Gravure printing**
- **Ink-jet printing**
- **Self-assembly of physical parts in continous**
- **Micro-additive manufacturing system for product encapsulation**
- **Ink sintering**

Devices

- **LED integration**
- **OLED**
- **Advanced encapsulants**
- **Control quality systems (e.g. 3D visión)**

Int/Assem

- **ICT systems for monitoring the manufacturing process at module level**
- **ICT systems for monitoring production at MES/ERP level**
- **Performance testing**
- **Mechanical and Electrical integration of diferente manufacturing technologies for high-througput production**

Applications

- Flexible Displays
- **Novel Lighting systems**
- Sensors
- **Smart textiles**
- **Smart packaging**
- Hybrid circuits
- **Lab-on-a-chip**

Markets

- **Lighting**
- **Electronics**
- **Food industry**
- **Textile industry**
- **Medical Diagnosis**

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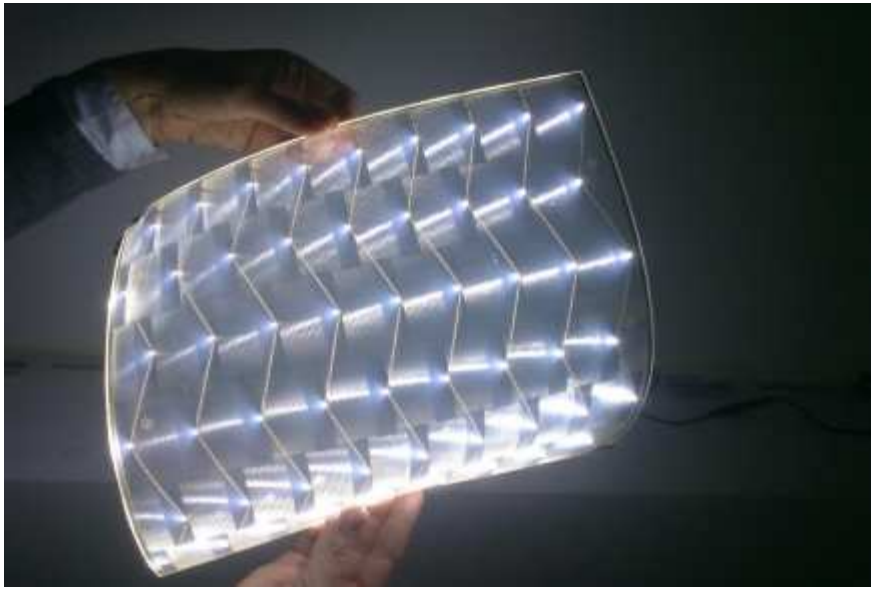
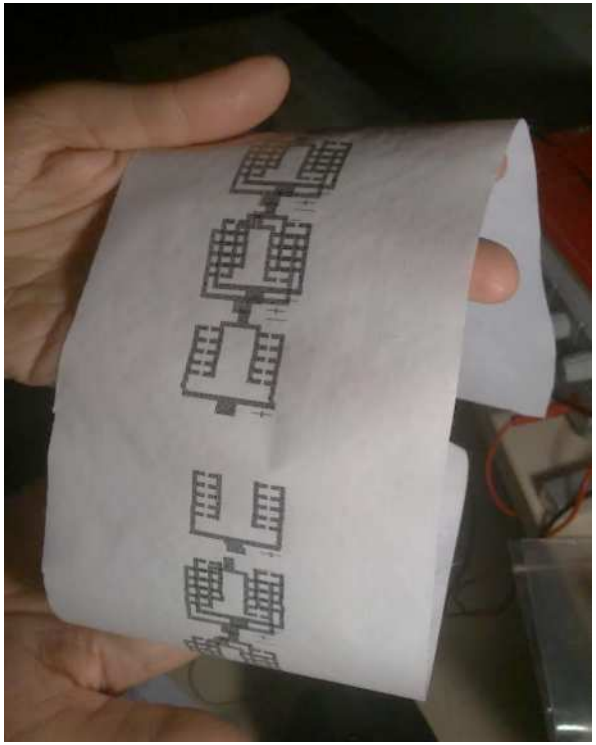
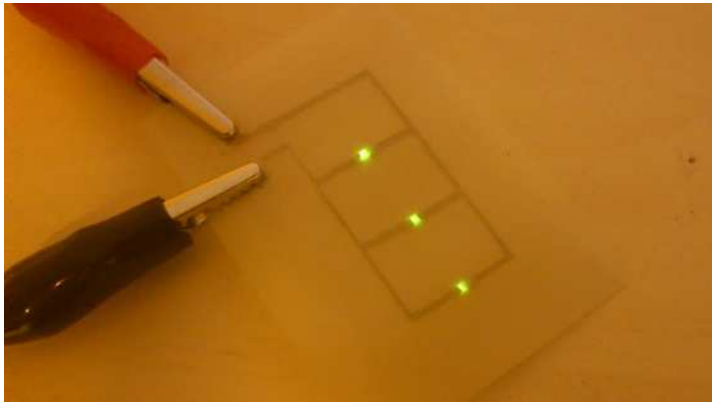
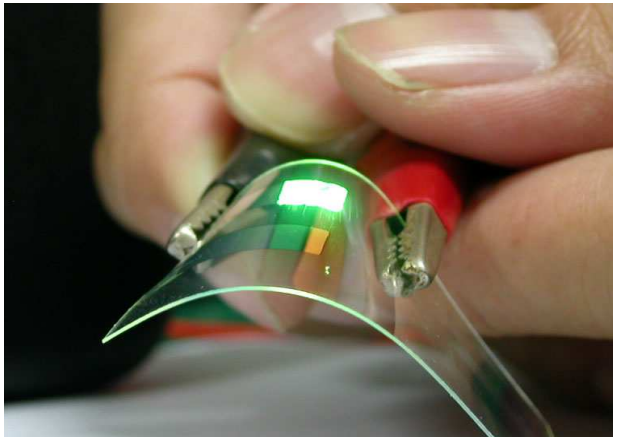
Product examples

Light-Rolls









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ACKNOWLEDGEMENTS

Light-Rolls

EuroNanoForum 2013

BEST PROJECT AWARD 2007-2013 – EUROPEAN COMMISION

Industrial Technologies 2014
SMART GROWTH THROUGH RESEARCH AND INNOVATION

SELECTED AS SUCCESS CASE OF FP7 PROGRAMME

SEVENTH FRAMEWORK PROGRAMME

EARTO
IMPACT DELIVERED

SELECTED AS SUCCESS CASE 2013 (European Association of Research and Technology Organizations)

HORIZON 2020
THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION

PRE-SELECTED AS SUCCESS CASE FOR PROMOTING HORIZON 2020

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THANK YOU!

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