

SUN PILOT

Sub-Wavelength Nanostructure Pilot Adaptable, Scalable Surface Nano-Patterning



Pilot production lines for the health, transport and industry-EPPN
Workshop, November 5th 2019, San Sebastian



This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 760915



Outline

- Introduction
- SUN PILOT Applications and Market Trends
- Competitive Advantages of SUN PILOT solutions
- Some achievements up to M22 in the Automotive Strand
- Description of SUN PILOT Pilots
- Business model

INTRODUCTION



Natures' nanostructures are able to reduce reflection, create colour and give self cleaning properties.



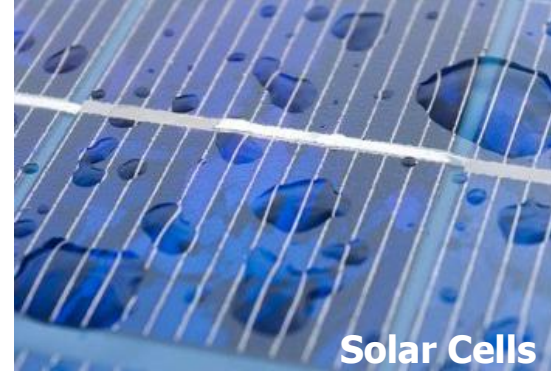
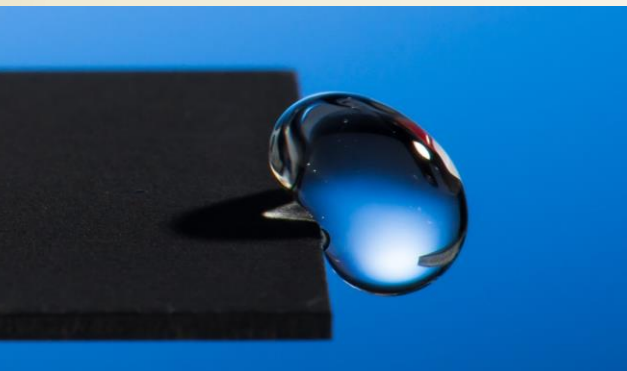
SUN-PILOT APPLICATIONS



Nanostructures etched into glass for the **optics industry**



Transferred onto plastic for the **automotive and related industries**





A disruptive non-coating technology

OPTICS INDUSTRY

- EU photonics sector has 18% share of global market of €350 billion, employing over 350,000 workers [1]
- EU leads world in production technology; optical components and systems; measurement and automated vision
- AR optics accounted for more than 40% of the global optics market in 2015, projected CAGR of 8.7%
- Direct impact: SUN-PILOT end-use partners aim for 15-35% revenue growth

[1] [Keynote Speech, Photonics21, 2016](#)

[2] BCC Research 2017

AUTOMOTIVE INDUSTRY (PLASTICS)

- Strategic industry in EU, 12.2 million people are employed in this sector [3]
- Automotive firms are Europe's largest private investor in research and development
- 2nd biggest consumer of injection moulds (after the packaging industry) for plastic forming
- 18,000 companies across Europe involved in plastic injection moulding
- Direct impact: SUN-PILOT end-use partners aim for 2% market capture, €60m p.a

[3] [EAMA Factbook](#)



COMPETITIVE ADVANTAGES



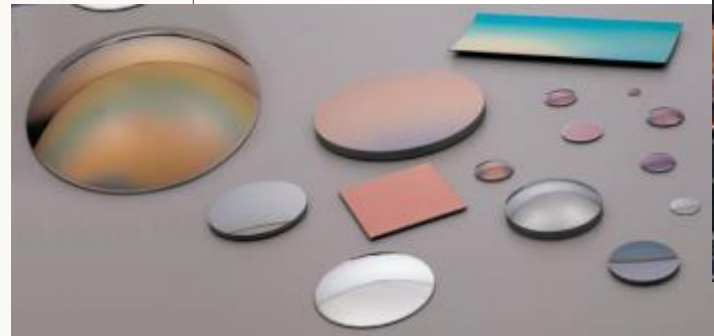
A disruptive non-coating technology

OPTICS INDUSTRY

- Direct surface modification **without use of multilayer dielectric coatings**
- Selectable wavelength response
- Saving energy and reduced cost - no need for high vacuum facilities
- No issue with delamination, uniformity, hotspots
- Anti reflective with high transmission

AUTOMOTIVE INDUSTRY (PLASTICS)

- Direct surface modification **without use of chemicals and pigments**
- Saving energy and reduced cost (capital equipment and operating)
- Superior performance



STRAND 2

AUTOMOTIVE DEVELOPMENTS

MAIN STRATEGIC DEVELOPMENTS

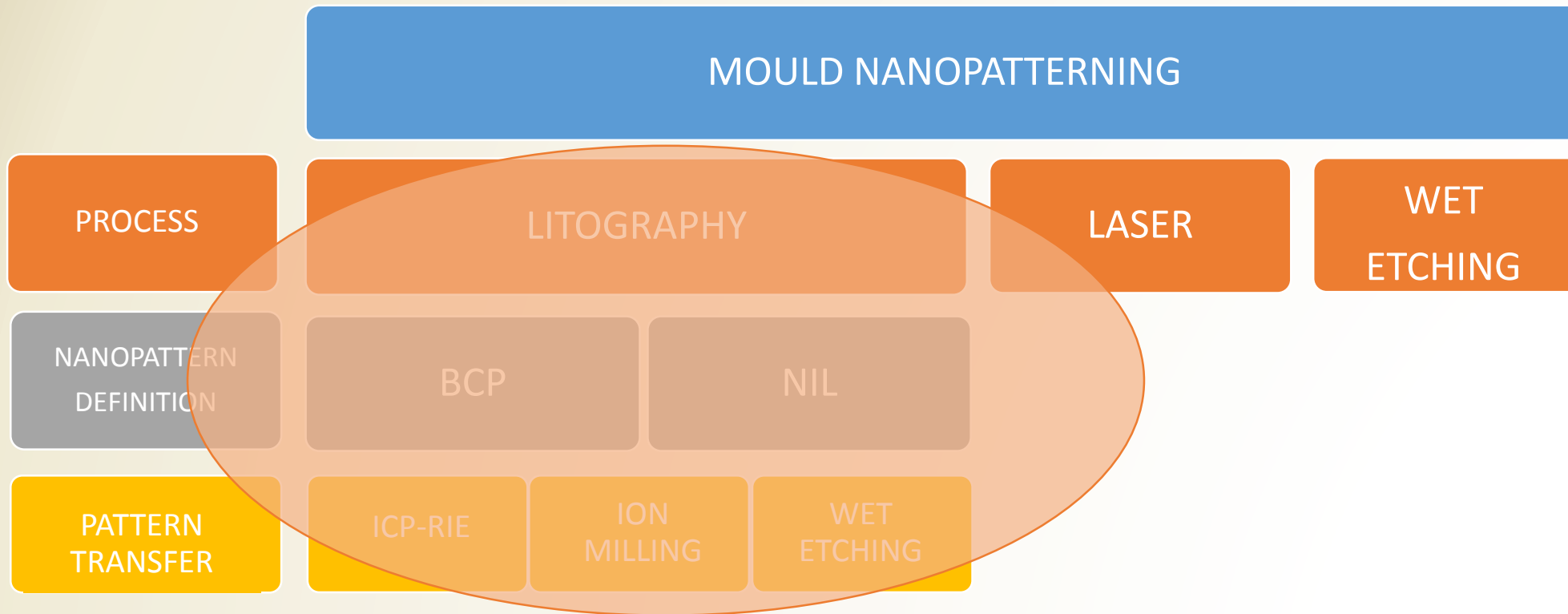
- Nanopatterned moulds (large area; robustness of the nanopatterns; etc..)
- Modification of polymers for easy-filling easy-peeling
- Combination of nanopatterning with additives for custom functionality

PILOT LINE: INJECTION MOULDING

- Optimized injection Moulding processes
- Validation of nanopatterned parts based on automotive industry regulation

MOULD NANOPATTERNING

Benchmarking of technologies for mould nanopatterning



Nanopatterning by Block Copolymer

1. BCP Film

- Make a polymer solution in an organic solvent
- Wash substrate (toluene, sonicate)
- Spin coat BCP

2 Phase separation

- Solvent Vapour Annealing
- Achieve phase separation and critical thickness

3. Metal inclusion

- Prepare metal hydrate solution
- Spin coat on to substrate
- Metal selectively infiltrates domains

4. Oxidise and remove polymer

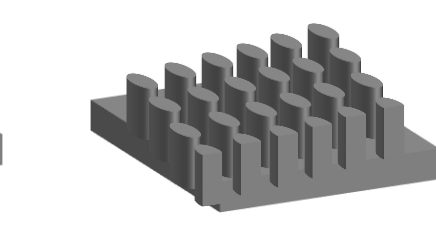
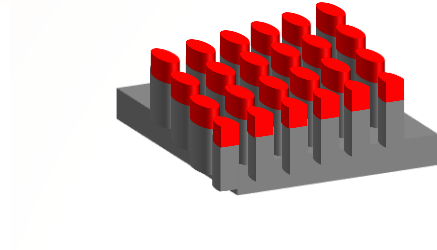
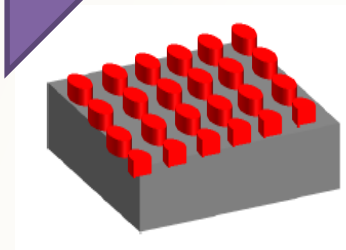
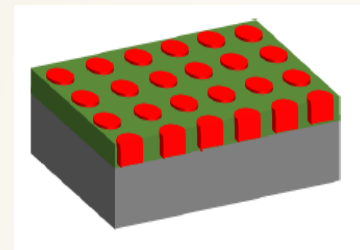
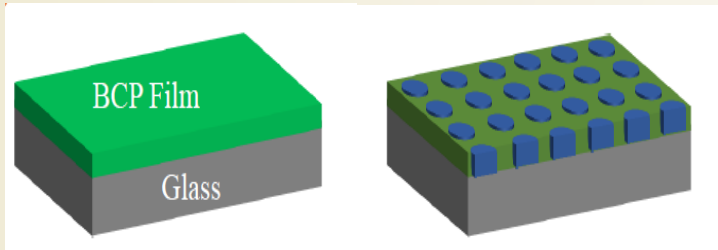
- Apply UV-Ozone

5. Transfer pattern to substrate

- Reactive ion etch

6. Finish

- Remove any remaining mask (wash / treat)
- Optics: Test performance
- Automotive: Use in Injection Mould to produce plastic part

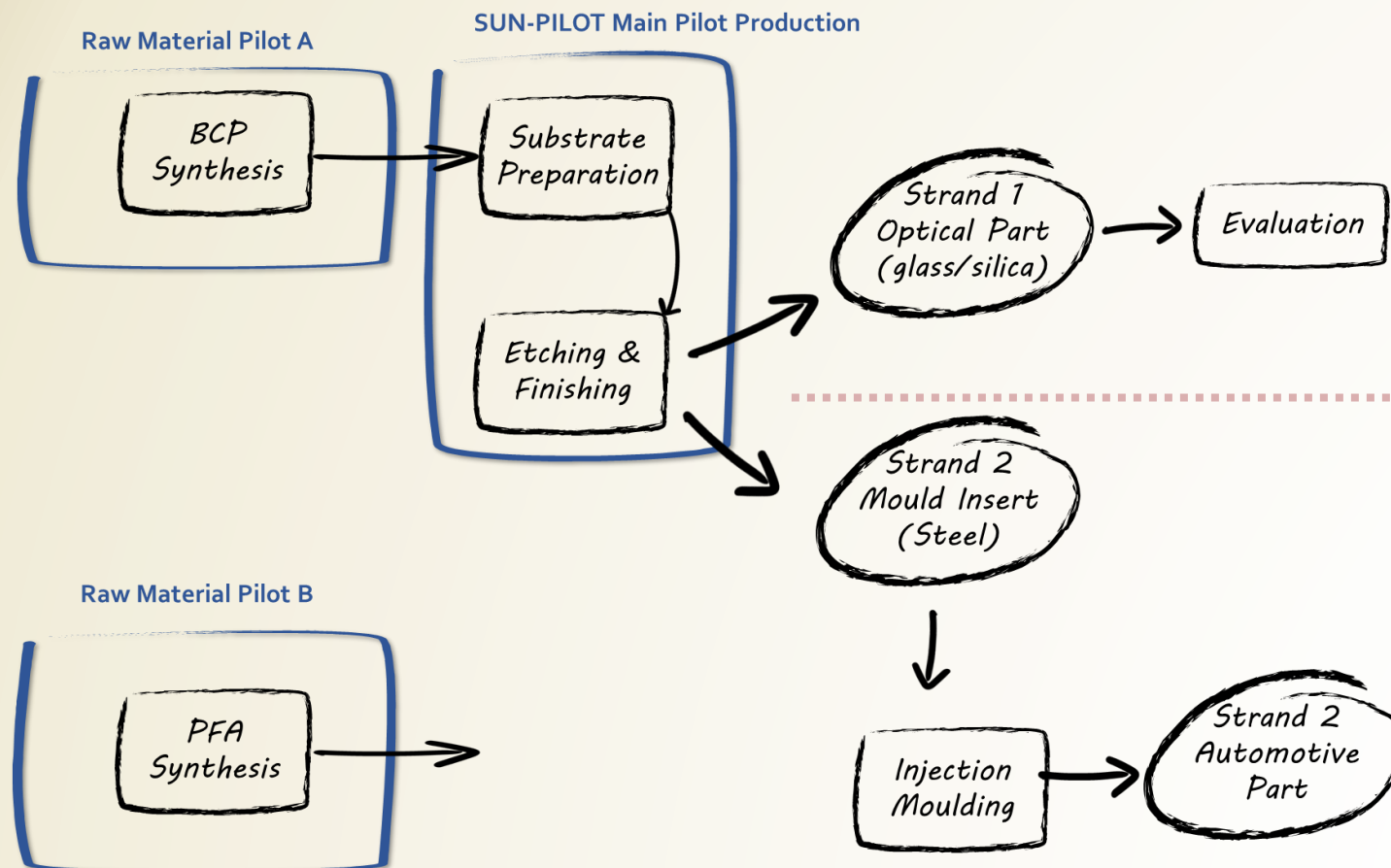


IJM parameters optimization

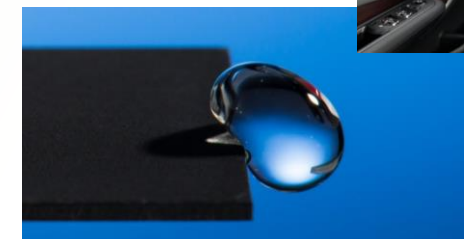
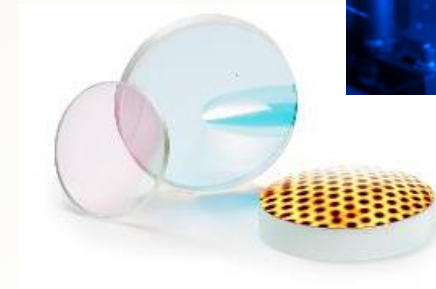
Parameters under study

- Temperature of the feedstock
- Pressure
- Temperature of the mould (inductive tools)

SUN PILOT - Pilots Overview







Optics Applications



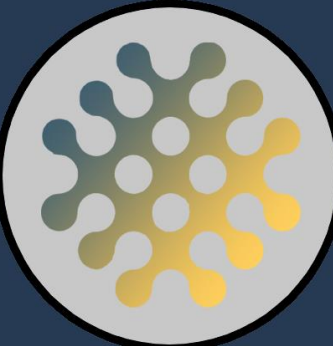
Automotive Applications

SUN PILOT Pilot Lines

<p>Raw Materials A: Block Copolymer Synthesis</p>	<p>Fraunhofer Institute for Applied Polymer Research (FHG-IAP)</p>	<p>Existing pilot facility New reactor, chiller</p>	 
<p>Raw Materials B: PFA Synthesis</p>	<p>micro resist technology GmbH (MRT)</p>	<p>New synthesis line</p>	
<p>Nanopatterning hard surfaces</p>	<p>(masking) Trinity College Dublin (R. I. etching) AMO</p>	<p>New masking line Existing etch facility</p>	 
<p>Injection moulding nanopatterned plastics</p>	<p>Grupo Antolin</p>	<p>Existing pilot facility New features (thermal management)</p>	

Exploitation model



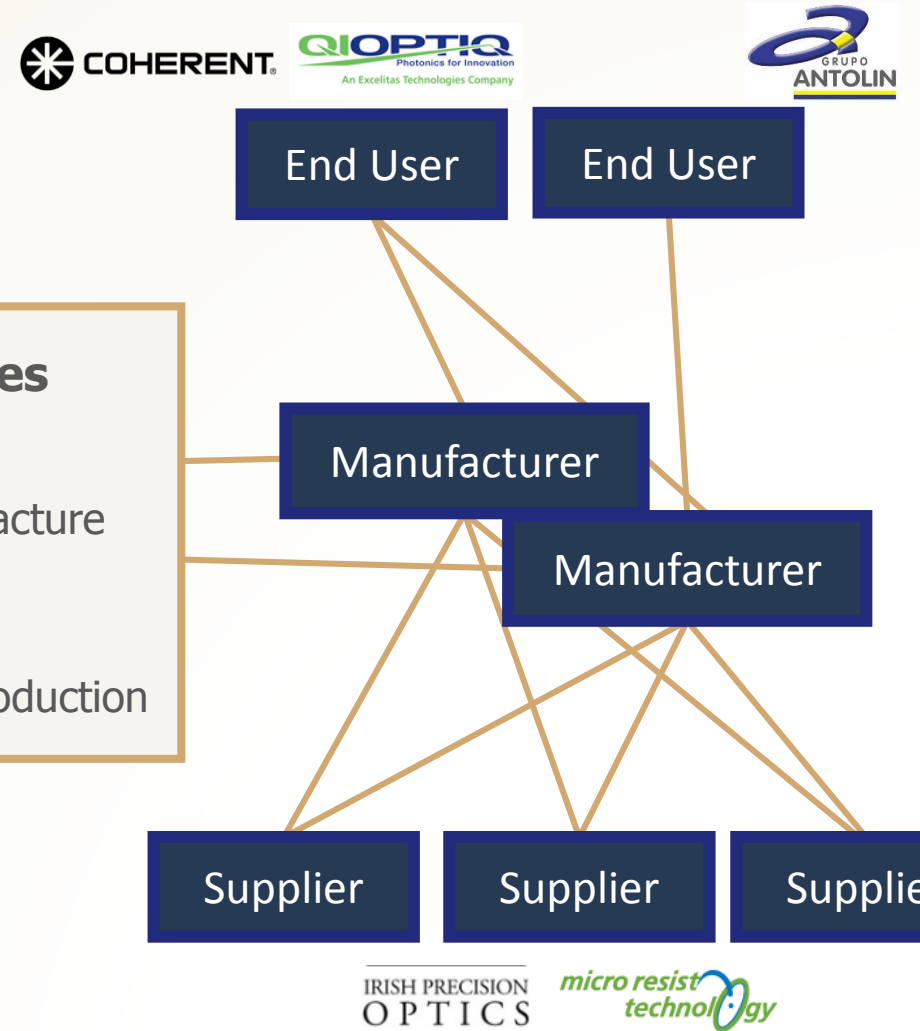


SPIN OUT

Technical Services

- Research
- Design for Manufacture
- Proof of Concept
- Tech Transfer
- New Product Introduction

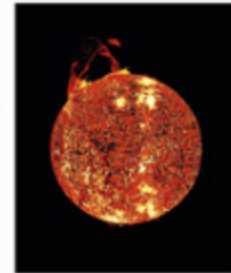
IP Holders



TEAM



SUN-PILOT across Europe: design, validation and application



Research



Industrial Development



Commercialisation

SUN-PILOT: Sub-Wavelength Nanostructure Pilot - Adaptable, Scalable Surface Nano-Patterning



Nanotextures Inspired by Nature Designed for Production

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