NewSkin: Innovation Eco-system to Accelerate the Industrial Uptake of Advanced Surface Nano-Technologies.

Value Propositions: Surface modification of membranes by Atmospheric Pressure Glow Discharge and functional finishing processes

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 862100 (NewSkin). The output reflects the views only of the author(s), and the European Commission cannot be held responsible for any use which may be made of the information contained therein.

NewSkin Range of Services To Be Provided And Key Target Industries:

Steel Construction | Ceramics | Water Treatments | Transport | Renewable Energy | Medical Device | Photonics

Commercialization of nano-enabled Consumer products with new functionalities

NEW SKIN

Design of Solutions
Technology Transfer
High Performance
Added Value
Advanced Features

Prototyping
Enhanced
Continuous
Mass Production
Processes

Performance Evaluation
Replicating highly demanding end use conditions

Benefits Quantification
LCA Approach
Economic
Social
Environmental
Regulatory

Industrial Uptake and Route to Market Support
Value Chains
Funding
Networking
Regulatory Issues
Nanosafety and Security

Commercialisation of Nano-enabled Consumer Products
New Functionalities
General Industry Focus:
Steel Construction
Ceramics
Water Treatments
Transport
Renewable Energy
Medical Device
Phototonics

NewSkin Value Proposition: Surface modification of membranes

- Initial case-studies with NewSkin partners will provide a first showcase of surface modification of membranes
- Others have the chance to apply for access to NewSkin OITB facilities through 4 open calls 2022-24
- NewSkin OITB upscaling facility for this value proposition include:

  ✓ *Atmospheric Pressure Glow Discharge (APGD) technology for surface preparation and modification of membranes*

  ✓ *Functional finishing technology for surface modification of membranes*

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NewSkin Value Proposition: Surface modification of membranes

Target 1: initial demonstrative case study on membranes with NewSkin partners will provide a first showcase for:

- **Nano-enabled membranes for water-treatment applications:**
  - ✓ Surface activation and generation of nano-roughness onto few-atomic layered graphene sheets.
  - ✓ Surface finishing of modified-graphene sheets for conferring surface functionalities

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NewSkin Value Proposition: Surface modification of membranes

Target 2: new value propositions for other case studies

- VP1: Atmospheric Pressure Glow Discharge (APGD) technology for surface preparation and modification of membranes
- VP2: Functional finishing technology for surface modification of membranes

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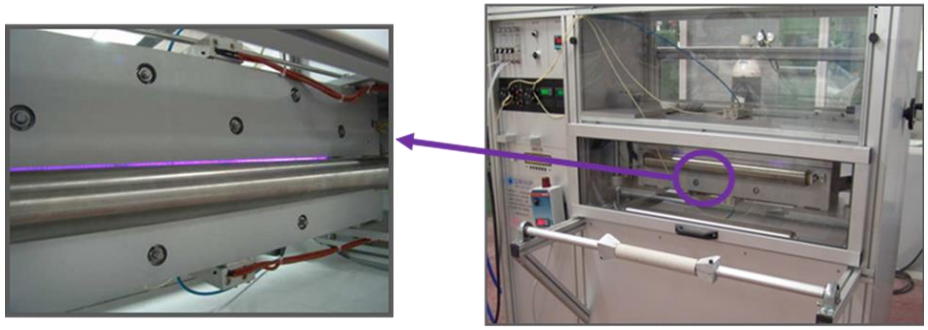
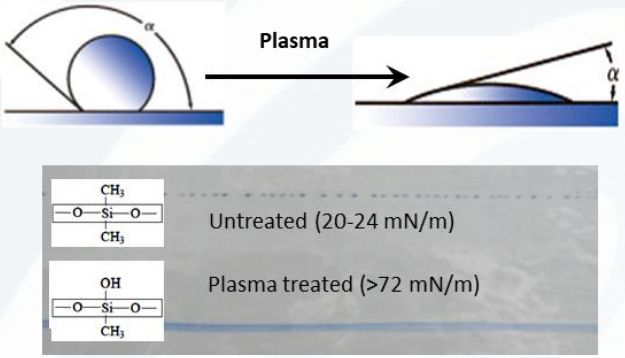
NewSkin Value Proposition: Surface modification of membranes

- Value proposition 1: APGD technology for surface preparation and modification of membranes

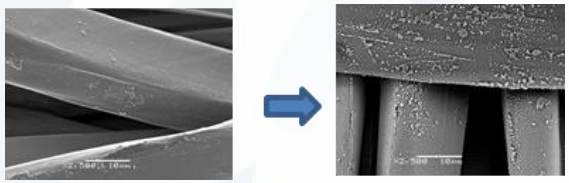


R2R APGD pilot-plant plasma system



Surface preparation

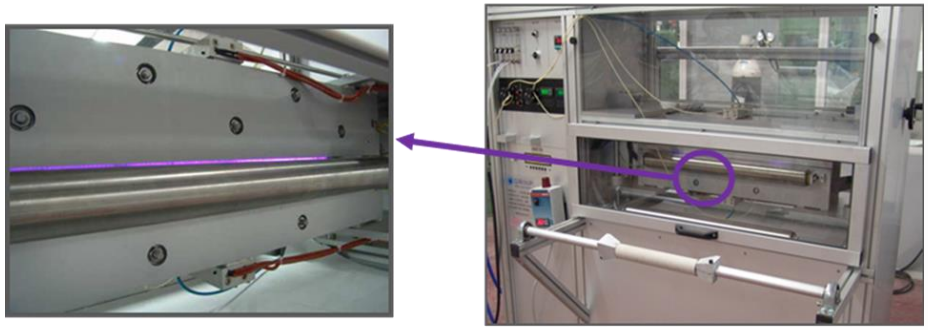
- ✓ Surface cleaning without modification of intrinsic properties
- ✓ Better wetting and adhesion before post-treatments



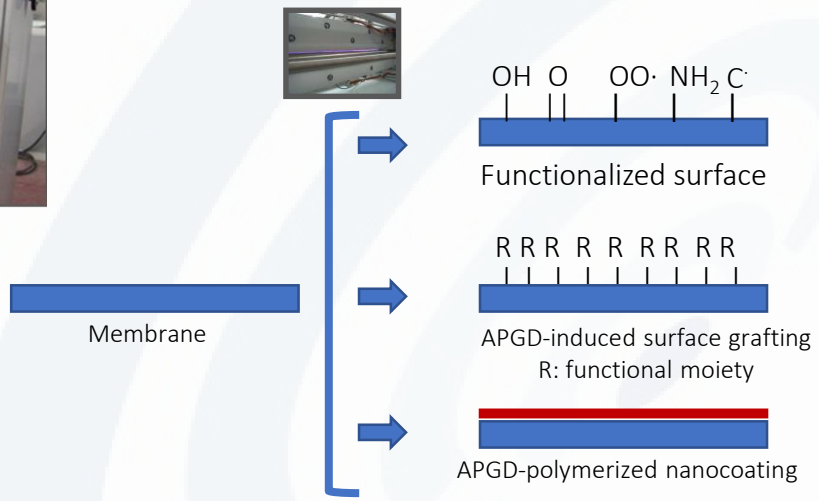
Plasma cleaning

NewSkin Value Proposition: Surface modification of membranes

- **Value proposition 1: APGD technology for surface preparation and modification of membranes**



R2R APGD pilot-plant plasma system

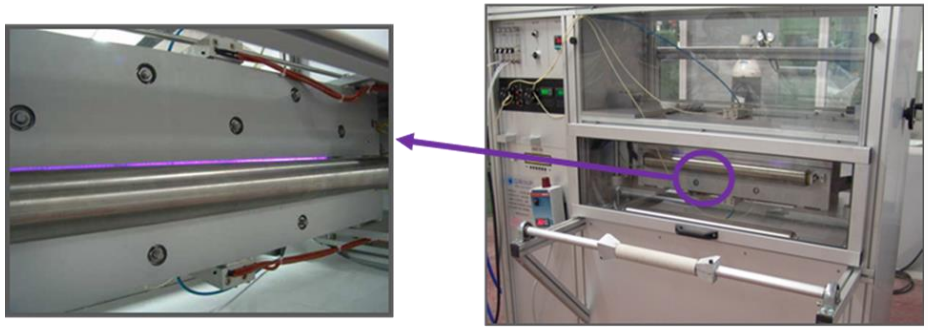


Surface modification

- ✓ Functional surface properties conferred:
  - Hydrophobic/oleophobic surfaces
  - Permanent hydrophilic surfaces
  - Antimicrobial surfaces
  - Abrasion resistant surfaces

NewSkin Value Proposition: Surface modification of membranes

- **Value proposition 1: APGD technology for surface preparation and modification of membranes**



R2R APGD pilot-plant plasma system

- ✓ *Controlled temperature inside the planar electrodes between 10ºC and 90ºC by water cooling*
- ✓ *Integrated temperature and humidity measurement*
- ✓ *Integrated safety system for operators*
- ✓ *Integrated extraction system for flue gases*

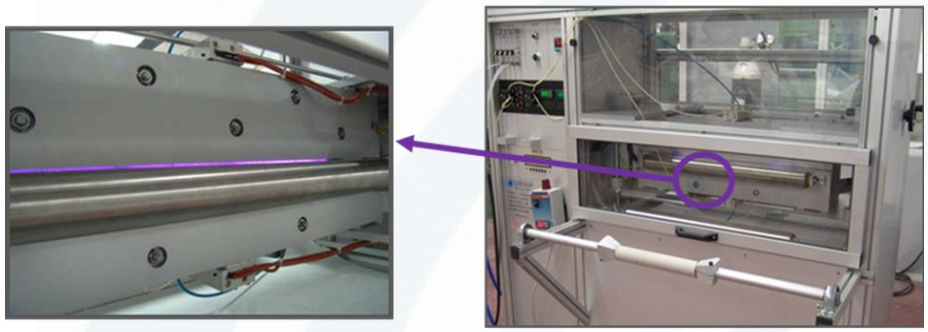
- ✓ Roll-to-roll (R2R) operation
- ✓ Processing speed: 0,1-10 m/min
- ✓ Power of discharge: 0-1-2.5 kW
- ✓ Gas flowrate: 0,01-5,0 L/min
- ✓ Distance between electrodes: 0,01-9,0 mm
- ✓ Continuous/pulse mode available
- ✓ Low frequency: 20-45 kHz
- ✓ High voltage: 1,5-10 kV
- ✓ High power: 10-30 W/cm^2
- ✓ Available gases: air, O_2, N_2, Ar, He
- ✓ Available precursors: under demand

NewSkin Value Proposition: Surface modification of membranes

- **Value proposition 1: APGD technology for surface preparation and modification of membranes**

Services offered:

- ✓ Generation of nanoroughness (1-40 nm) onto few-atomic layered graphene sheets
- ✓ Surface activation of membranes to improve wetting and adhesion before functional finishing processing
- ✓ Surface functionalization:
  - Hydrophobic/oleophobic surfaces
  - Permanent hydrophilic surfaces
  - Antimicrobial surfaces
  - Abrasion resistant surfaces
- ✓ Optimization and reproducibility of safe and environmentally friendly APGD processing



R2R APGD pilot-plant plasma system

NewSkin Value Proposition: Surface modification of membranes

- **Value proposition 2: Functional finishing technology for surface modification of membranes**

- ✓ *Integrated with anti-splatter system*
- ✓ *Integrated ventilation device for being connected when using toxic/dangerous substances*

- ✓ Roll-to-roll (R2R) operation
- ✓ Horizontal foulard
- ✓ Processing speed: 0,1-15 m/min
- ✓ Pressure: 0,1-5 kg/cm^2
- ✓ Drying/curing system already available (<250ºC)

NewSkin Value Proposition: Surface modification of membranes

- **Value proposition 2: Functional finishing technology for surface modification of membranes**

Services offered:

- ✓ Functional surface finishing:
  - Hydrophobic/oleophobic surfaces
  - Permanent hydrophilic surfaces
  - Antimicrobial surfaces
  - Abrasion resistant surfaces
- ✓ Functional surface finishing process onto APGD-treated membranes for:
  - ✓ Improving productivity due to better wettability
  - ✓ Improving durability due to better adhesion
- ✓ Optimization and reproducibility of safe R2R functional finishing processing

NewSkin Value Proposition: Surface modification of membranes

Applications	Substrates	Markets
Modification of nano-roughness	Graphene sheets, polymeric filters, polymeric laminates, polymeric films	Filtration for water treatment and food industry; personal protective equipment such as filters and textile laminates for respirator masks; microperforated food packaging for fruits and vegetables
Surface activation / preparation	NF, UF and MF membranes; textiles; paper; polymeric films/laminates	Filtration for water treatment (detergents, MBRs) and food industry (wine clarification, juice clarification, beer filtration, oil-in-water filtration, skim milk filtration, protein recovery and pollution reduction for fish and poultry applications); technical textiles; printed paper; food packaging
Surface modification / functionalization	NF, UF and MF membranes; textiles; paper; polymeric films/laminates	Filtration for water treatment (detergents, MBRs) and food industry (wine clarification, juice clarification, beer filtration, oil-in-water filtration, skim milk filtration, protein recovery and pollution reduction for fish and poultry applications); hydrophobic/oleophobic textiles and paper; permanent hydrophilic textiles/paper; antimicrobial/antivirus textiles/paper/films; abrasion resistant textiles/paper

NewSkin Value Proposition: Surface modification of membranes

- Target customers/end-users

✓ **Manufacturers of graphene sheets for filtration applications**

- Controlled nanoroughness for designing filtration capabilities and performance

✓ **Manufacturers of polymeric filters for water treatment and food industries for conferring:**

- Antifouling behaviour: less maintenance operations and increased durability
- Permanent hydrophilic properties: improved productivity (higher flowrate), reduced energy consumption (lower ΔP)
- Abrasion resistant surfaces: increased durability

✓ **Manufacturers of technical textiles for conferring:**

- Hydrophobic/oleophobic properties by environmentally friendly low-cost APGD technology
- Permanent hydrophilic properties for comfort (i.e. breathability)
- Antimicrobial/antivirus properties for PPE, medical textiles, home textiles, public areas, transport, etc.
- Abrasion resistant surfaces for technical textiles

✓ **Manufacturers of printed/laminated paper for conferring:**

- Hydrophobic/oleophobic properties by environmentally friendly low-cost APGD technology
- Hydrophilic properties for paper laminates avoiding primers
- Antimicrobial/antivirus properties for printed books, journals, etc.

Summary of our services

- Generation of nano-roughness onto few-atomic layered graphene sheets
- Surface functionalization of membranes (i.e. hydrophobic/oleophobic, permanent hydrophilic, antimicrobial/antivirus, abrasion resistant) by APGD technology and/or surface finishing processing

References

- Previous research and development projects in LEITAT:

  - ✓ Antifouling and selective membranes:
  - ✓ Functional finishing on membranes:
  - ✓ Innovative membranes:
  - ✓ Reusability of membranes:

Thank you!

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