

3D Direct printing on non-conventional substrates

Multifunctional products based on 3D Direct Printing

3D Direct Printing has the potential to personalize 3D products and integrate electronics without adding weight avoiding (or reducing) the use of PCBs

At TECNALIA, we believe that 3D Direct Printing is a key set of processes that will be used in the development of added value products which will significantly modify the way electronics are embedded in common objects:

- Plug&play injected parts with embedded cablings
- Highly integrated illuminated panels
- Antennas on 3D objects, etc..

“3D DIRECT PRINTING IS A KEY SET OF PROCESSES WHICH MANY BELIEVE WILL DECREASE THE USE OF PCBs”

Our approach

Thanks to our state-of-the art equipment and know-how in materials, we are able to develop prototypes on a large variety of non-conventional substrates. As a result, feasible solutions are designed and transferred.

Here we present the platform that we have conceived to address the applications:

- Materials/Substrate selection/modification, if needed
- Ink Formulation/re-formulation, if needed
- Design of the 3D circuit and printing pathway on a 5-axis system
- Imprinting 3D process optimization. Multilayers including conductive, dielectric and/or sensing layers
- Hybridation and connecting solution (pick&place in 3D)
- Functional Characterization
- Prototyping final 3D products

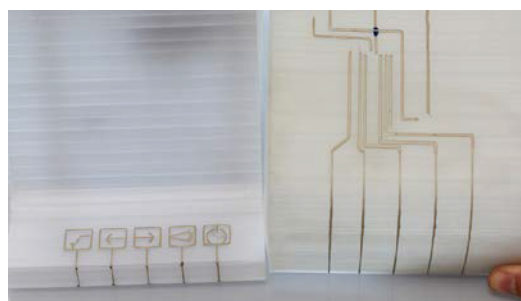
3D Direct Printing techniques available

TECNALIA has a set of printing processes available for a wide range of substrates, curvatures, targeted applications, etc.:

- **Micro-Dispensing:** EV5 3 AXIS-Nordson
- **Aerosol-Jet Printing, Piezojet:** and **Dispensing** on 5 AXIS PJ15X (Neotech)
- and **several curing techniques:** Laser, UV curing, UV-LED, Forming



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Functional printing at TECNALIA

Novel properties, multifunctionality, smart and printed electronics are some of the areas that can be addressed by Functional Printing.

Novel inks, upgraded printing machines and new processes are opening the door to obtain products with enhanced functionalities.

A number of new applications are made possible thanks to this technology: sensors, heating elements, cable substitution or illumination circuits to name a few..

“FUNCTIONAL PRINTING IS A KEY SET OF PROCESSES WHICH MANY BELIEVE WILL SIGNIFICANTLY IMPACT OUR DAILY LIFE AND BENEFIT TOMORROW’S SOCIETY WITH REDUCED ENVIRONMENTAL IMPACT”



Printing techniques available

TECNALIA has a set of printing processes available for a wide range of substrates, curvatures, targeted applications, etc.: **Screen-printing:** AUREL Automation model 900 and EKRA E2; **Ink-jet printing:** Dimatix DMP2831; **Micro-Dispensing:** EV5 3 AXIS-Nordson; **Aerosol-Jet Printing, Piezojet and Microdispensing** on PJ15X (Neotech); **Gravure, Flexo, Gravure Offset and Lamination:** KPP (RK printcoat Instruments); **Lithographic techniques** (EVG620): photolithography; microcontact printing, **UV-NIL and Thermal-NIL** and **several curing techniques:** Laser (VCSEL and Rofin 100W), UV-LED (Phoseon), UV curing, Forming, etc..

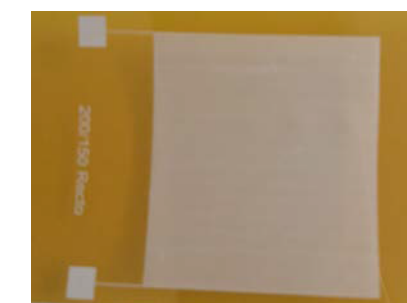


Our approach

Thanks to our sound technological knowledge and our state-of-the art laboratories, we are able to develop prototypes and transfer them to industry.

Here we present the platform that we have conceived to address the applications:

- Materials/Substrate selection
- Ink Formulation/re-formulation
- Electronic design
- Imprinting and hybridization process optimization
- Functional Characterization
- Prototyping final products: composites, plastic parts, metallic or ceramic substrates, flexible substrates including textiles and/or complex 3D parts



Temperature Printed Sensor on Kapton

Strain Printed Sensor on textile

Printed functions embedded in composites

Composites with embedded functionalities: sensors, heating elements, illumination circuits, ..

TECNALIA has developed and patented a process to embed functions in composites drastically minimizing the damage introduced in the structure.

At TECNALIA, we believe that our process to embed functions in composites based in printed laminates is key in the development of added value composite products and will significantly modify the way multifunctional composite parts are manufactured.

Applications under development:

- Illumination panels with touch buttons
- Embedded Heating elements
- Strain sensors for SHM continuous monitoring
- Embedded temperature sensors
- Antennas

“Our patented process is able to minimize the introduction of structural damage and/or delamination in composites”

Our approach

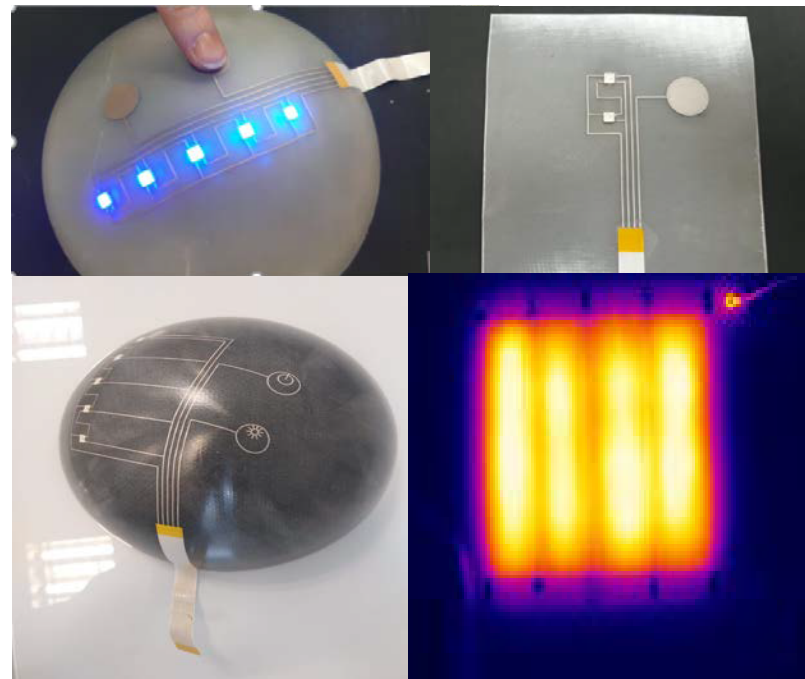
Our sound technological knowledge, both in composites and in printing and thanks to our state-of-the art laboratories, we are able to develop multifunctional composites without introducing delamination or voids. Mechanical tests (on-going) promise no reduction of the ILSS and mechanical strength properties.

Here we present the platform that we have conceived to address the applications:

- Inks Formulation/re-formulation, if needed
- Imprinting process optimization:
- Printing multilayers: conductive, dielectric and/or sensing layers with microdipsensing/screen-printing
- Hybridation and Connecting solutions
- Thermoset and thermoplastic composite processes
- Functional Characterization
- Prototyping final composite products



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Composite processing techniques tested

THERMOSET

RTM (Resin Transfer Moulding)
Infusion
Prepreg
Hand Lay-up
Roll-Forming
Filament Winding
....

THERMOPLASTIC

In-Situ Polymerization
Consolidation
Hot-stamping

Novel printable veils for composites and textiles

Laminate composite structures with printed functionalities

TECNALIA has developed printable veils that can be laminated to obtain highly performant composites and textiles. The main advantages of these veils for Printed Electronics are:

- Fine lines (<100µm) can be printed
- and the stretchability properties (160%).

Moreover, these veils not only mechanically reinforce the composites but also present functionalities per se, such as: anti-bacterial, electrical and thermal conductivity and aesthetic properties.

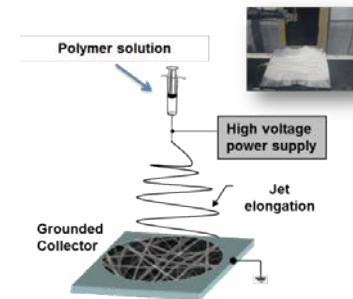
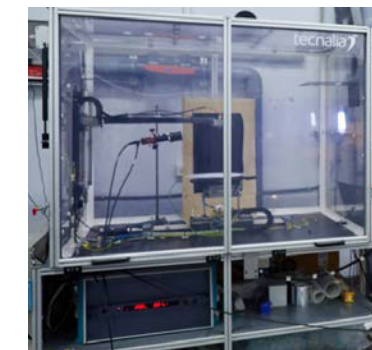
Applications under development:

- Illumination panels with touch buttons
- Embedded Heating elements
- Pressure and temperature sensors
- Intelligent membranes

“Our patented veils can be stretched more than 160% and we are able to print lines as fine as 100µm wide”



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Veils have been developed by electrospinning: a low-cost process to obtain nano and micro scale fibers by means of applying an electrostatic field between the needle and the grounded collector from a polymer solution.

Printed veils can be easily embedded in fiber reinforced composites due to their high porosity and chemical compatibility.....

Our approach

Our sound technological knowledge, both in composites and in printing enables us to develop multifunctional composites and smart textiles ready to be transferred to the market.

In **TECNALIA'S FUNCTIONAL PRINTING PLATFORM**, our approach is to generate knowledge which can lead to high added value materials and products, ensuring economic impact and job creation coming from the resulting industrial applications.

To this end, we take part in EU projects collaborating with key players in this field.