

The background of the slide is a microscopic image of a material surface, showing a complex, layered structure with various textures and colors ranging from dark purple to light pink. A white hexagonal logo is positioned to the right of the company name. The logo consists of a hexagon with a white triangle inside, pointing towards the top-left corner.

# Graphenano

COMPOSITES

**Corporate presentation April 2023**

# What is graphene?

## NANOMATERIAL

Its dimension is less than or equal to one millionth of a millimeter.

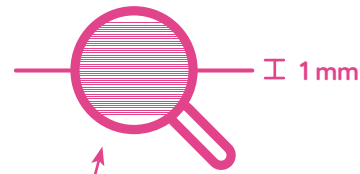


0,142 nm

Carbon atoms are tightly held together on an even surface, as it were a honeycomb.

## BIDIMENSIONAL

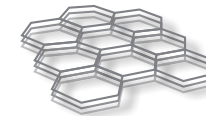
It only presents two dimensions because it is only one-atom-wide ( $10^{-9}$  mm).



3 millions of graphene sheets stacked up

## PURE CARBON

As *graphite*\* and diamonds.



\* *Graphite* is composed of many graphene sheets, stacked up one over the other.

# Graphene main properties

## Resistant

200 times more than steel



## Bidimensional

100.000 times thinner than human hair



## Flexible

Up to 20% with no damages



## Environmentally-friendly

Subustainable and biodegradable



## Biocompatible

Applications in Medicine field



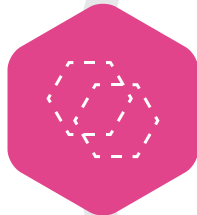
## Light

1 m<sup>2</sup> weights less than one gram and you can cover more than 400 square meters



## Transparent

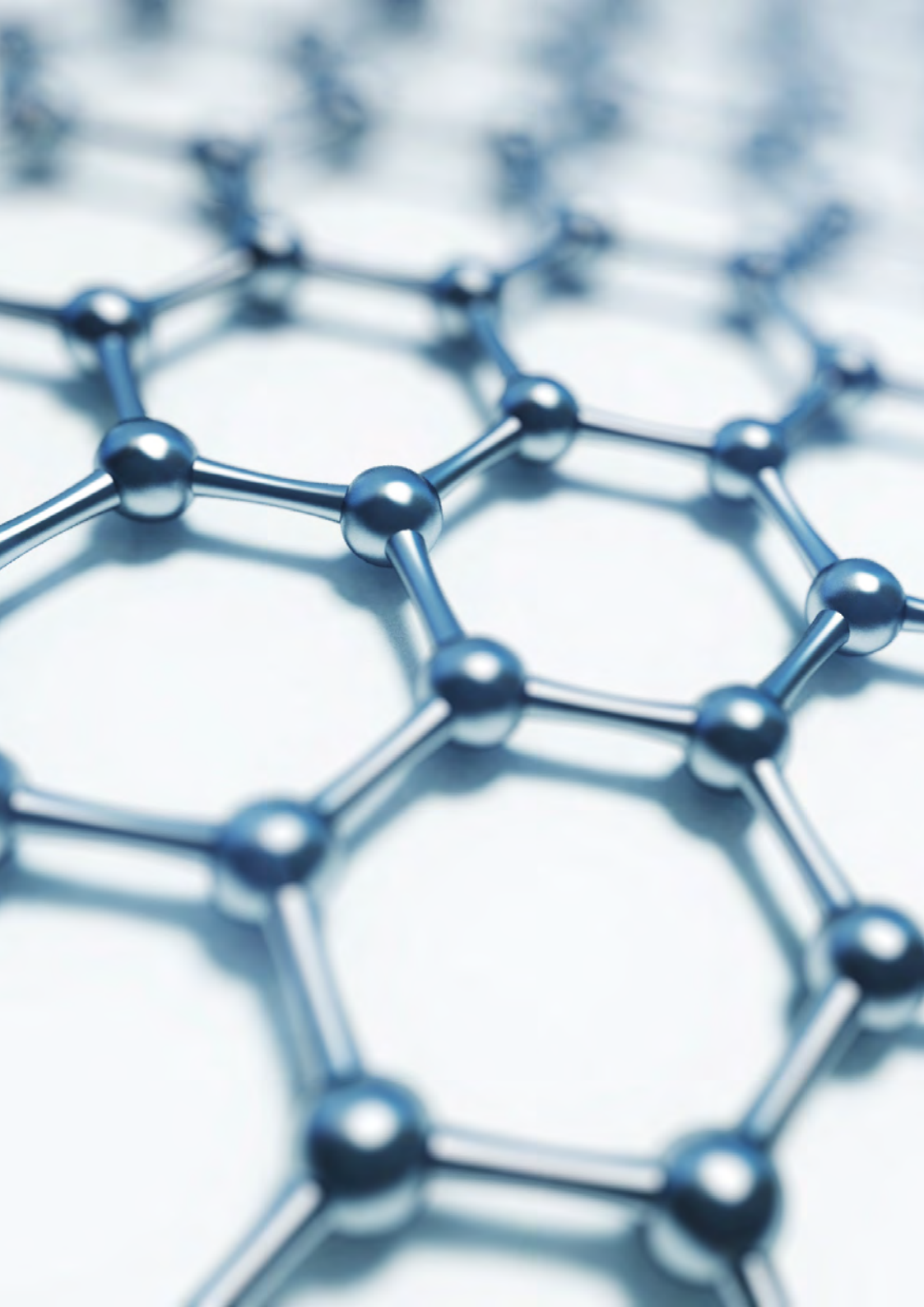
98% of transparency, similar to glass



## Conductive

Electrical and thermal conductivity, better than copper





Graphene and variants are nano materials with incomparable stiffness and strength principally due to the strength of carbon-carbon (covalent) atomic bonds.

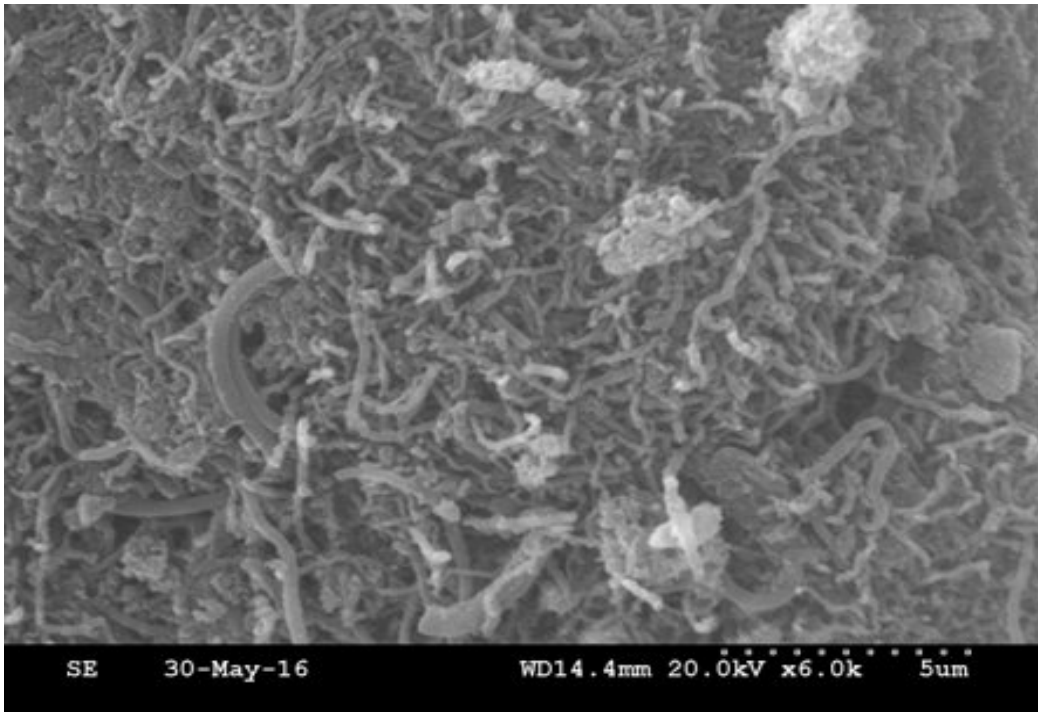
- Elements based on carbon bonds; diamond, graphite and graphene come to have highest measure modulus and strength in a material so far.

**Young modulus= 1 Terapascal= 1 000 Gpa= 1 000 000 Mpa**

**Ultimate strength= 100 Gpa = 100 000 Mpa , at 20 % strain**

- Steel break at 500 Mpa, graphene is 200 times stronger than steel.

Graphene is a material with the best electric conductivity known, the best heat transfer, the biggest modulus and strength and others “exotic” properties...



## Graphene modified resins

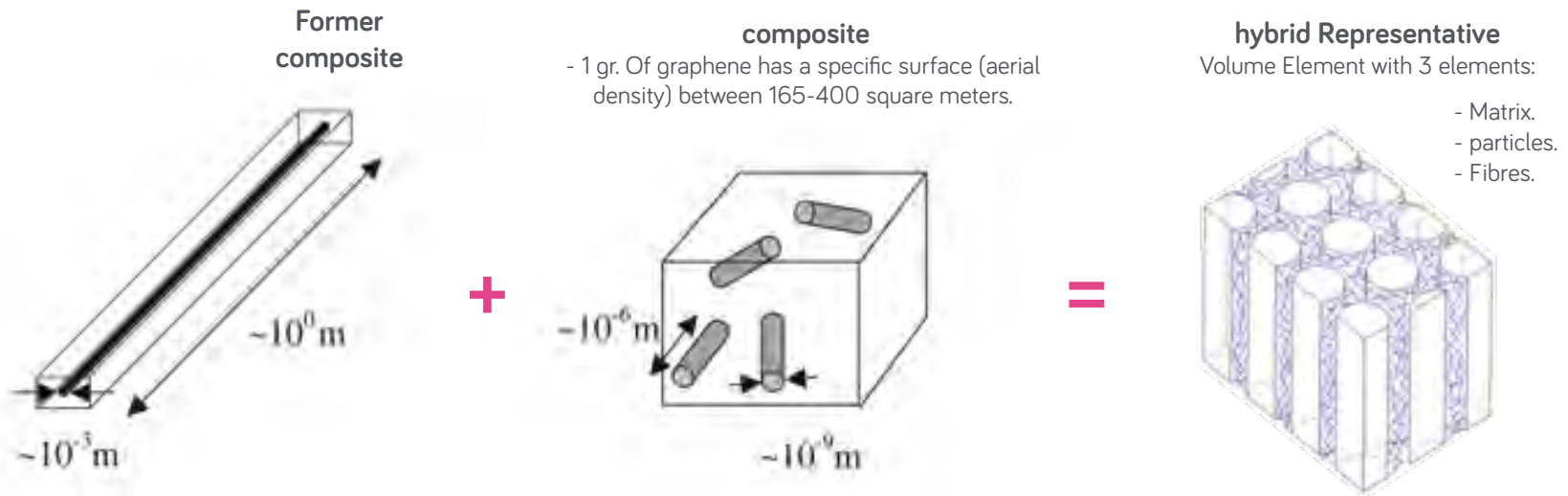
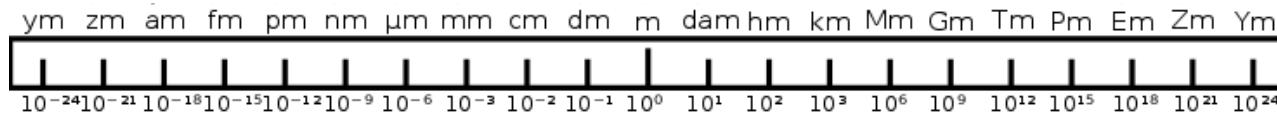
Once the reactor stage is finished, a solvent-based dispersion (masterbatch) is added to the resins at high temperature in the dilution process. This masterbatch contains the graphene particles, functionalized and predispersed for their proper integration in the final formula.

Particles contain functional groups on their surface capable of creating bonds with the rest of the polymer network and with the sizing of the fibers. In this way, the properties of the graphene material are integrated into the final composite forming a hybrid system.



# Graphene modified resins

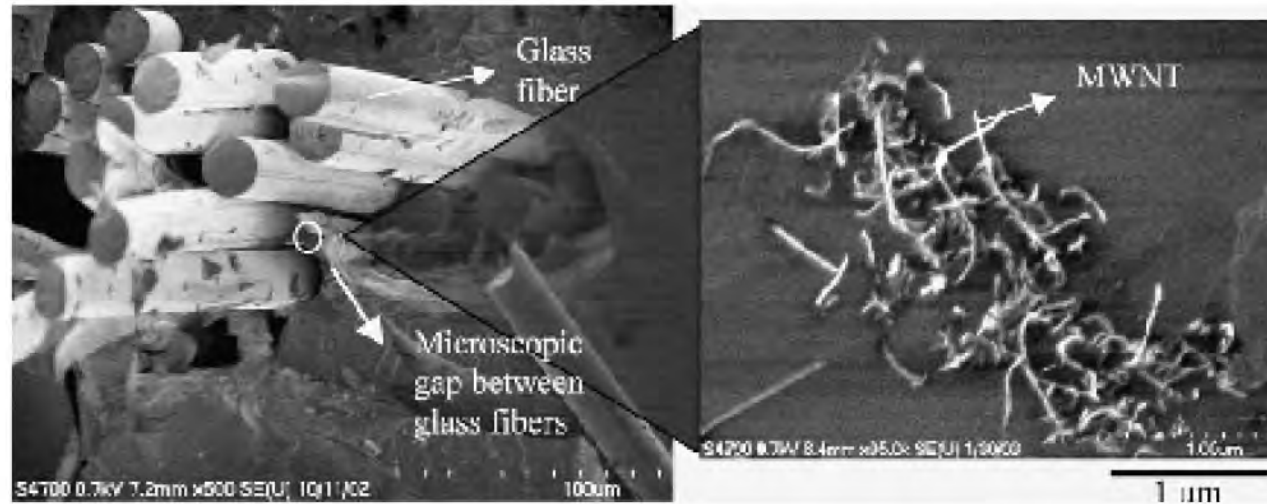
## 2. HYBRID COMPOSITES THEORY



material can transfer some interesting properties to final composite.  
 Functionalized particles promote interfacial bonding with the surrounding matrix and fibre sizing.

# Graphene particles act:

- As stress concentration points in a matrix
- Promoting the prolongation of microcracking
- Act as physical bridges to cracks in the matrix, preventing crack propagation
- Carry a higher load due to their stiffness and strength
- Conductive network



## Resin Transfer Molding for Manufacturing Hybrid Nano-/Micro- Fibers Reinforced Polymer Composites [1,2]

# Improved properties in the composite

The main known properties of graphene and that are transferred to resins and, by extension to composite, are the following:

By using CompoGraph resins, composites can improve exponentially its technical properties, such as:



**Resistance**



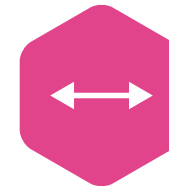
**Lightness**



**Hardness**



**Elasticity**



**Elongation**



**Thermal  
conductivity**



**Electrical  
conductivity**



**Impermeability**



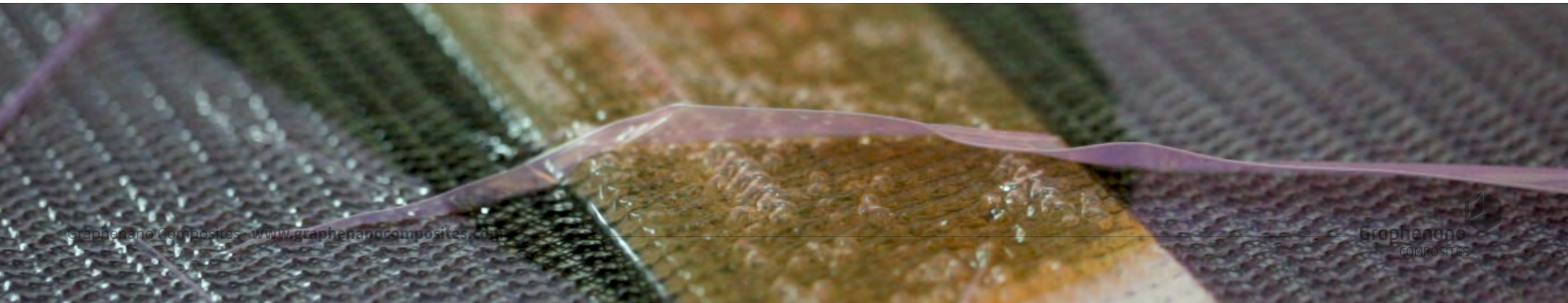
**Bacteriostatic  
effect**



# Improved properties in the composite

Some properties that have been studied and implemented in the Compograph range of resins are listed below. The greatest advantage in mechanical properties is obtained in laminates formed by unidirectional and multiaxial reinforcements.

- The **molecular network** is more complete at equal times, this generally causes the manufactured products to reach their mechanical properties and hardness earlier, allowing greater productivity without changing other properties.
- Increase in **elastic modulus of 10-20%** in the direction of the fiber.
- **30% increase in tensile strength** in the direction of the fiber.
- The **breaking mechanism** is different, the stresses in deficient fibers are transmitted to adjacent fibers, delaying the breaking of the material.
- **20-30% increase in modulus** and resistance in the direction perpendicular to the fiber.



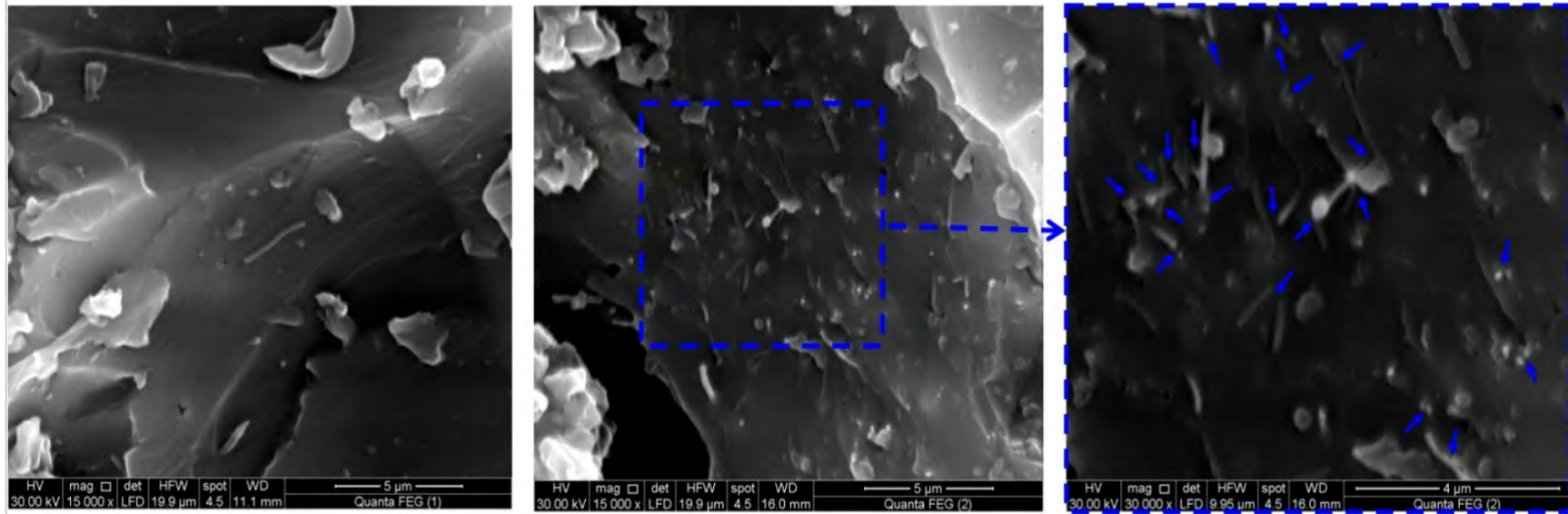


# CompoGraph

GRAPHENE RESIN

- The interlaminar resistance values are practically the double that expected in products with a high fiber content (pultrusion).
- The glass transition temperature (TG) is increased in value.
- The HDT of the resin is also increased.

- The characteristic effect of reduced properties that occurs in compression by buckling of fibers, due to their misalignment, is drastically diminished or disappears, allowing the structures to be optimized.
- The flexural fracture tests show fracture in the tensile face instead of the usual in compression. This results in a large increase in flexural tensile properties (> 50% in continuous yarn).
- Lifetime (fatigue) studies of our customers show increases of up to 5 times in the maximum number of load cycles. The loss of mechanical properties is much less for equal cycles.



(a)

(b)

(c)

(a) 0.5 wt %; (b) 2.0 wt %; and (c) a close view

The thermal transmission is superior allowing the resin to reach the processing temperatures in less time and thermal dissipation capacities in finished products.

- Customers have reported increases of 40-45% in “dielectric strength”.
- Customers of pultrusion with Compograph 70 TP resin declare higher conductivities.
- Parts made with Compograph allow the discharge of static electricity to the ground.



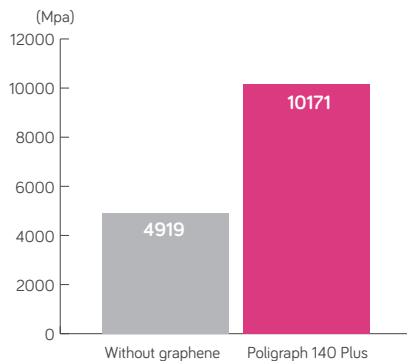
# RESINS

## Graphenano Composites

### POLIGRAPH 140 PLUS

POLIGRAPH 140 PLUS is a state-of-the-art orthophthalic polyester resin modified with graphene nanotechnology, for use in the manufacture of hybrid composites that considerably increase their mechanical, physical and biological properties. It is a fully polymerisable resin with medium reactivity. It has high temperature and fire resistance.

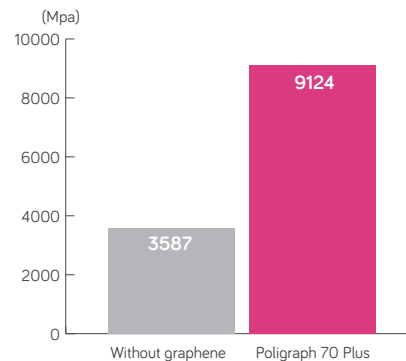
POLIGRAPH 140 PLUS is pre-accelerated with cobalt salts and contains a toxicotropic and UV protection agent.



### POLIGRAPH 70 PLUS

POLIGRAPH 70 PLUS is an isophthalic polyester resin of the latest generation modified with graphene nanotechnology, for use in the manufacture of hybrid composites that considerably increase their mechanical, physical and biological properties. It has excellent water, temperature and fire resistance.

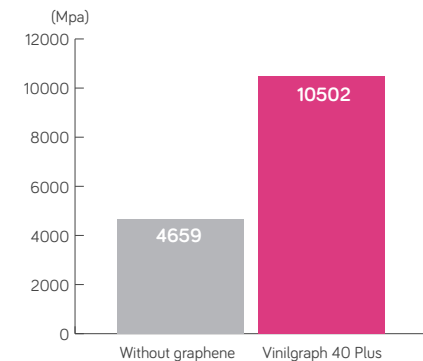
POLIGRAPH 70 PLUS is pre-accelerated with cobalt salts and contains a toxicotropic and UV protection agent.



### VINILGRAPH 40 PLUS

VINILGRAPH 40 PLUS is a state-of-the-art vinylester-type resin modified with graphene nanotechnology, for use in the manufacture of hybrid composites that considerably increase their mechanical, physical and biological properties. High chemical resistance, excellent corrosion resistance, as well as excellent reaction to fire.

VINILGRAPH 40 PLUS is pre-accelerated with cobalt salts and contains a toxicotropic and UV protection agent.





# Some success stories with Compograph

Cantilevered canopy installed in Valencia, (Spain). Piece of 340 m<sup>2</sup> made from composite with graphene, the biggest manufactured by nanotechnology in the world. Self-supported structure with a three-dimensional shape and double curvatures that presents exponential improvements in terms of strength/weight, durability and behavior against external agents.



Pultrusion profiles of fiberglass and CompoGraph resin doped with graphene. This results in profiles which are much more resistant and rigid, protected against hydrolysis and bacteria, and more durable. Their mechanic properties are being certified by TUV,



The first boat in the world made from graphene composite, which grants the boat far superior performance standards in terms of resistance, lightness and durability. This has meant the elimination of hydrolysis and microcracking of the gel-coat, as well as significant cost-savings and a reduction of environmental pollution. Graphenano One is the lightest, fastest and most environmentally friendly boat in the sector.

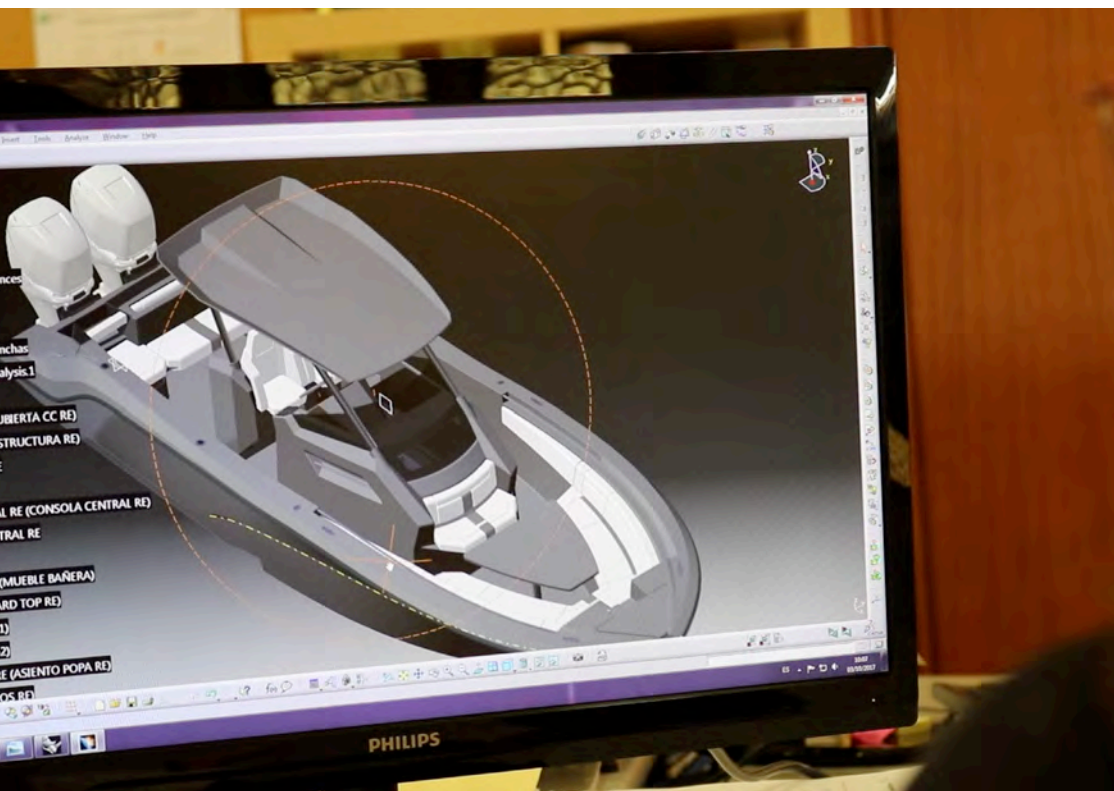




## Graphenano One

**Graphenano One** is the World's first ship made of Graphene hybrid composite. It is a pleasure boat of more than 9 meters length. Its weight, thanks to graphene, has been reduced by 20% compared to a similar boat made of typical composite structure.

Graphene increases the mechanical properties of strength and resistance of the composite and optimizes the amount of material used. In addition, it reduces wear and tear and increases the durability of the boat. Graphenano One is lighter, faster, has a lower resistance to advance and guarantees greater stability and safety.







# Nanotec Signals

**Nanotec** signals are the first in the world to be manufactured with graphene composite.

These signals are made with CompoGraph resin, which increases its mechanical features such as resistance to traction, compression and shear. The optimization of materials provides the signs with greater lightness compared to steel or aluminum signs, making them very competitive.



LIGHT, ELASTIC  
AND SAFE



CORROSION-FREE



LOW ENVIRONMENTAL  
IMPACT



RESISTANT  
TO LOADS



SNOW-RESISTANT



WIND-RESISTANT



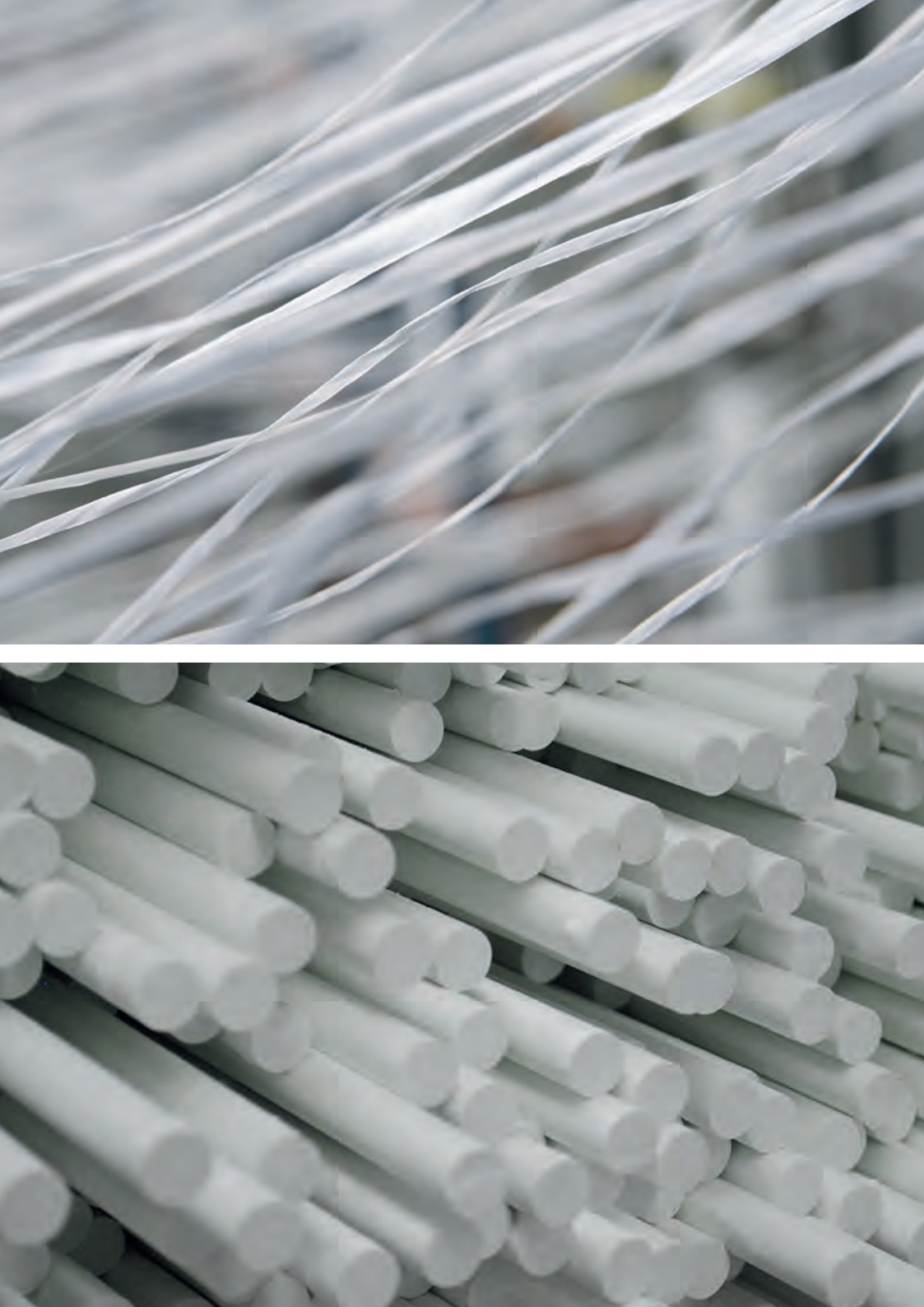
LOW  
RESIDUAL VALUE



LOW  
MAINTENANCE



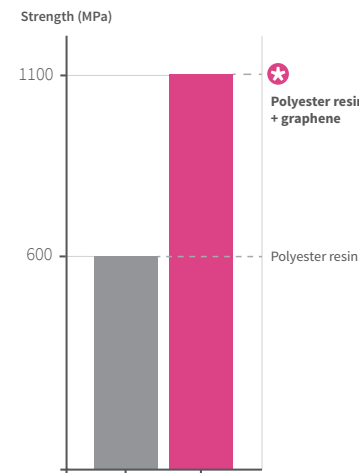
LOW INSTALLATION  
AND TRANSPORTATION  
COST



# Pultrusion profiles

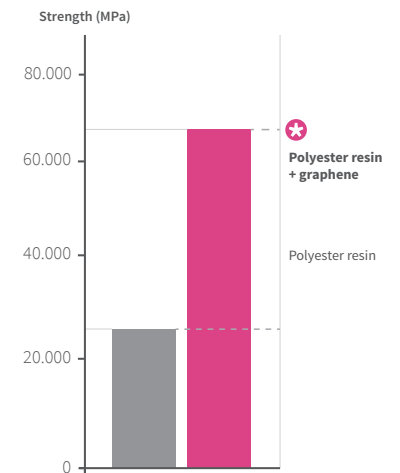
Pultrusion profiles of hybrid composite, They are made with nanomodified resins with graphenic material from the **Compograph** range, developed by Graphenano Composites.

**FLEXURAL STRENGTH**  
(PULTRUSION)



Tests according to UNE-EN ISO 14125 regulation.

**ELASTIC MODULUS**  
(PULTRUSION)



Tests according to UNE-EN ISO 14125 regulation.

*In the process of certification with TUV SUD Iberia mechanical properties, In the process of fire resistance certification with AFITI, with a preliminary classification A2-s1,d0*





## Salt & Potash warehouse (Barcelona Harbour)

More than 40.000 linear meters of composite profiles manufactured by our partner Polymec. With Compograph resins.

“The use of profiles with Compograph resin allowed competitive advantages over standard GRP composite profiles, such as a higher elastic modulus. Thus, allowing the reduction of the number of supports used in the structure, as well as the reduction of the section of some of the profiles with a significant cost reduction of the global structure”.



















## Dakar light vehicle parts

The “buggy” of the Graphenano-Vehilsxtrem team was the first car in the World to compete in the Dakar Rally, which incorporates graphene hybrid composites. This vehicle has different composite parts with graphene-modified resins from our Compograph range, manufactured by Graphenano Composites. Graphene gives these pieces greater resistance and toughness; essential properties in the hardest rally in the World.



Graphenano Group:



**Graphenano Composites**  
info@graphenano.com

Calle Pablo Casals, 13.  
30510 · Yecla, Murcia (Spain)  
t. (+34) 965 108 102

[www.graphenanocomposites.com](http://www.graphenanocomposites.com)