

GROUP PRESENTATION

Graphenano 
nanotechnologies

Strictly private & confidential

Graphenano is the world's leading group in graphene production at industrial scale. Its unique manufacturing system allows us to supply graphene in different formats such as nanofibers, nanospheres and graphene oxide.

Graphenano group is the result of years of research and close collaboration with different Spanish Universities. Since it was born in 2012, Graphenano has explored the opportunities and applications of graphene (I+A) with one goal: give a solution to every business opportunity emerging from the revolutionary properties this new material offers.



**Graphenano
Group**



WHAT IS GRAPHENE?

NANOMATERIAL

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

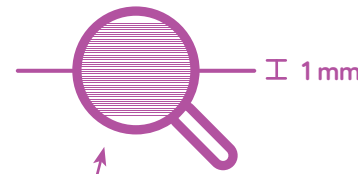


0,142 nm

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).

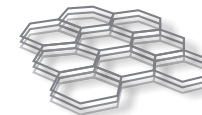


1 mm

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.

It is no surprise that graphene, as a substance with electrical and thermal conductivity, mechanical strength and optical purity than any other, is being heralded as the “wonder material” of the 21st century, as plastics were in the 20th century

Resistant
200 times more than steel



**GRAPHENE
MAIN
PROPERTIES**

Bidimensional

100.000 times thinner than human hair

Flexible

Up to 20% with no damages

Environmentally-friendly

Subustainable and biodegradable

Biocompatible

New applications in Medicine and dental field. Antibacterial

Transparent

98% of transparency, similar to glass

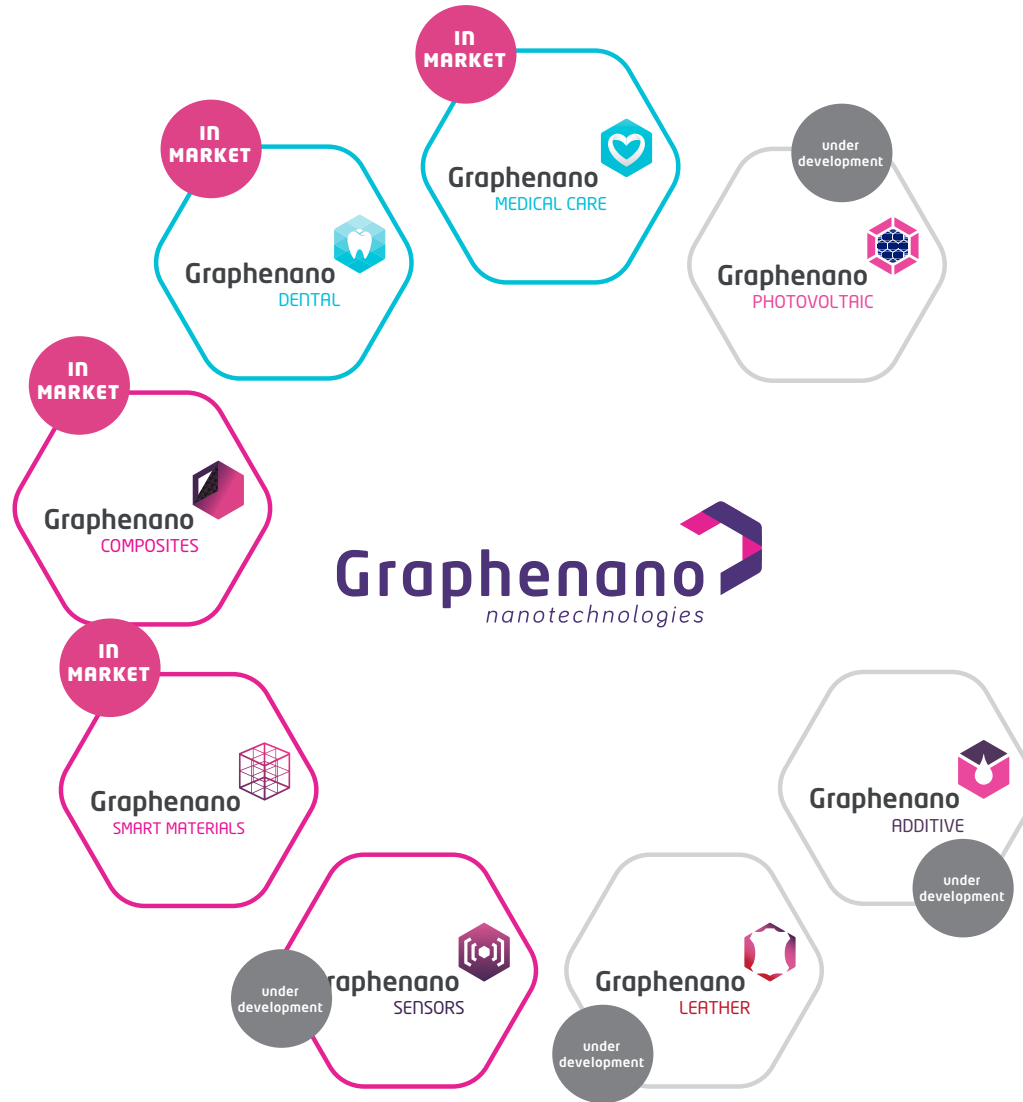
High Conductivity

Electrical and thermal conductivity, better than copper

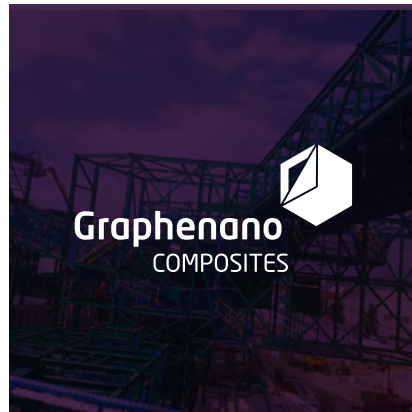
Light

1 m² weights less than one gram

GRAPHENANO GROUP

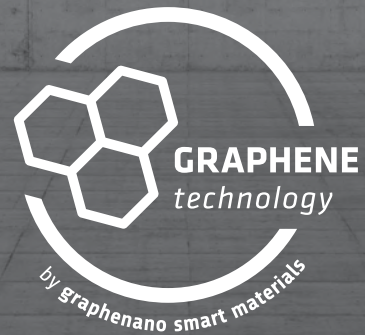


APPLICATIONS ON MARKET



Smart**ADDITIVES**

GRAPHENE CONCRETE

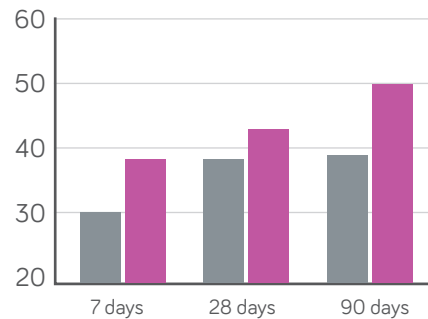


Technology Features with graphene

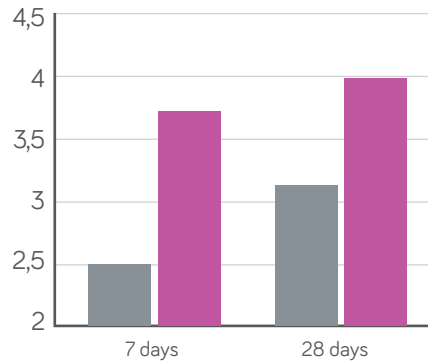
Ref. VS Mechanic Graphene Fluid PREMIUM

■ Ref. ■ Mechanic Graphene Fluid PREMIUM

Evolution of compression resistances (MPa)



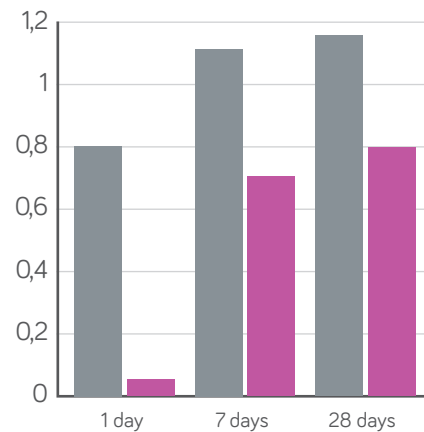
Evolution of flexion resistances (MPa)



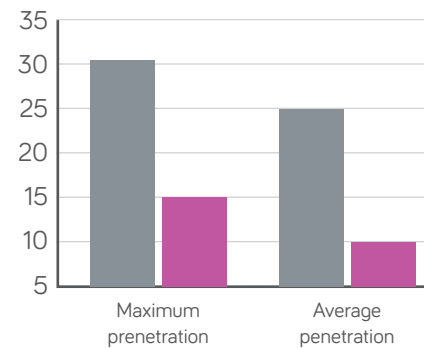
Ref. VS Hard Graphene Durability PREMIUM

■ Ref. ■ Hard Graphene Durability PREMIUM

Capillary water absorption



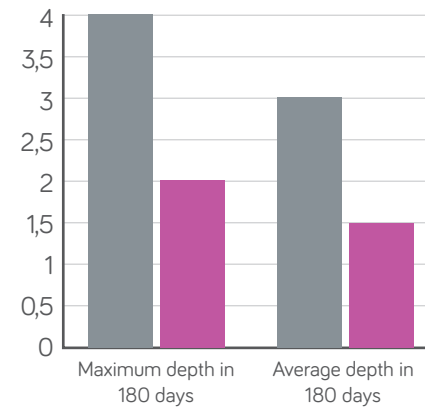
Penetration depth (mm)



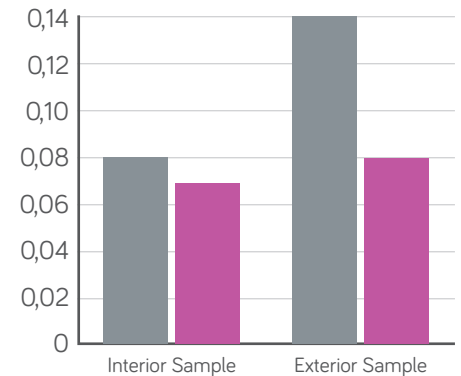
Ref. VS Hard Graphene Durability PREMIUM

■ Ref. ■ Hard Graphene Durability PREMIUM

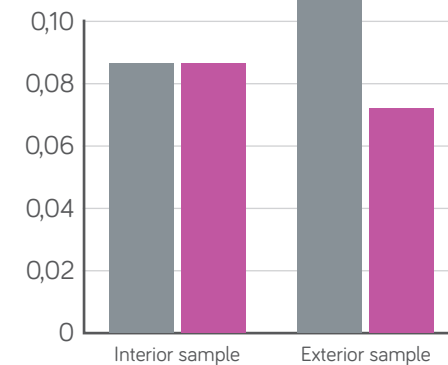
Carbonation depth (mm) in marine-aerial environment



% Chlorine after 90 days submerged in marine water



% Chlorine after 180 days exposed in marine-aerial environment





- + **Environmentally friendly: reduces CO₂ emissions.**
- + **50% more protection against chlorides and sulphates**
- + **60% improvement against carbonation**
- + **Up to 60% improvement in the protection of submerged hydraulic concretes.**

Graphenano
SMART MATERIALS



SmartCOVER μ

GRAPHENE FINISHING

SmartCOVER improves the mechanical and environmental features of conventional micromortar by including graphene additive in its composition.



Higher resistance



Hardness to impact



Water-repellent



Bactericidal effect



Elasticity



Conductivity



Longer durability



Better workability

Water-based graphene nanodispersions for integration in manufacturing processes for concrete additives and construction products.

These solutions are specially designed for manufacturers of products in the construction sector, and can in any case be configured and adapted to the manufacturing processes and requirements of each manufacturer.

This technology provides improvements in mechanical performance, durable performance and maximum efficiency in its products..

- + **Improvement in mechanical performance**
- + **Durable performance improvement**
- + **Maximum efficiency of polymers and technologies in which it is used.**



Graphene concentrates for solutions in construction products





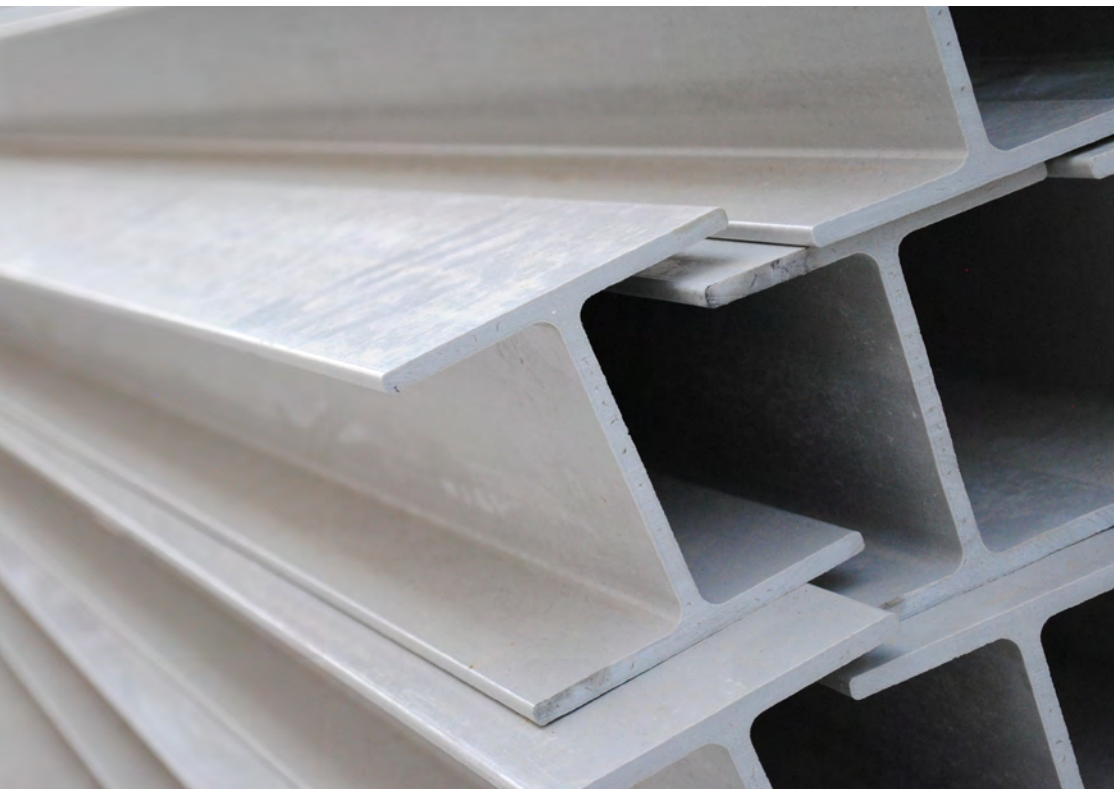
Improved plasters with graphene

- + **Compression enhancement 20-25%**
- + **Improvement in flexion 20-30%**
- + **Improves hardness (Shore-C) 10-15%**
- + **Improvement in absorption by capillarity 20-25%**
- + **Density increase (g/cm³) 10-15%**



CompoSmart

GRAPHENE COMPOSITES



A wide range of fiberglass reinforced resin profiles with graphene additives



Greater structural rigidity

The CompoSmart profiles have a higher elasticity modulus than standard materials.



High mechanical resistance

The mechanical properties of the polyester resin with graphene are similar or greater than higher cost and higher technology resins (vinylester – epoxy bisphenol A).



Protection against hydrolysis and bacteria

Graphene has positive properties against the effects of hydrolysis and bacteria.



Greater durability

Resins altered with graphene have a greater durability with the same design.



Same density

The stoichiometric mix of polyester altered with graphene does not cause changes in density or viscosity.



Lower weight, lighter

Resin altered with graphene allows for a product with a reduced weight but the same mechanical characteristics without influencing its durability.



Same density

The stoichiometric mix of polyester altered with graphene does not cause changes in density or viscosity.



Higher traction resistance

Thanks to graphene, the ultimate tensile strength is increased by more than 30% when compared with the standard GFRP profile.

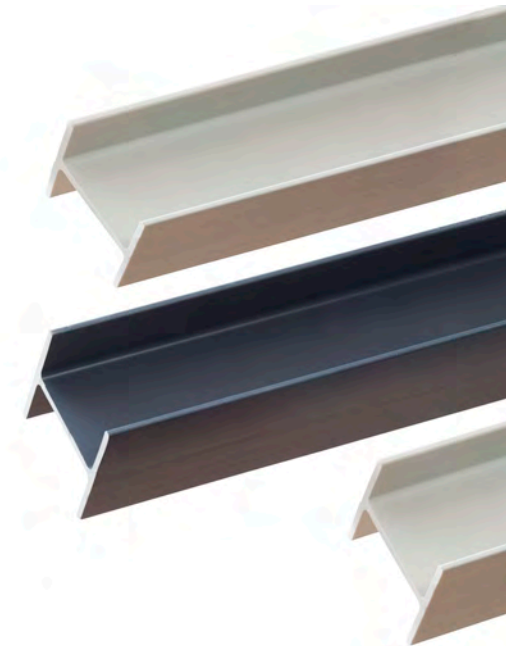
Graphenano
COMPOSITES



CompoSmart

GRAPHENE COMPOSITES

Construction of special product warehouse has been built in the port of Barcelona, with graphene composite bars. Total of 35,000 linear meters of profiles of different types.



Graphenano
COMPOSITES



CompoGraph
GRAPHENE RESIN

“CompoGraph” is a range of graphene enhanced resins manufacture and distribution by Gazechim, leading European company in the sector.



Resistance



Lightness



Hardness



Elasticity



Elongation



Thermal conductivity



Electrical conductivity

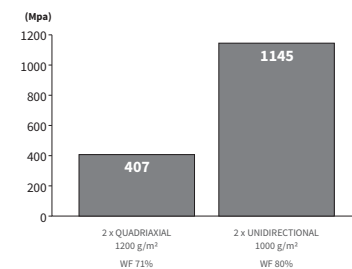


Impermeability



Bacteriostatic effect

Flexural strength (ISO 14125)



- Ecological and environmentally friendly reduction of raw materials mainly derived from oil up to 60%.

- Allows the use of more economical resins, since graphene polyester resins with fiberglass have same features as high-end price resins..

- hydrolysis Elimination.

- Waste Minimization

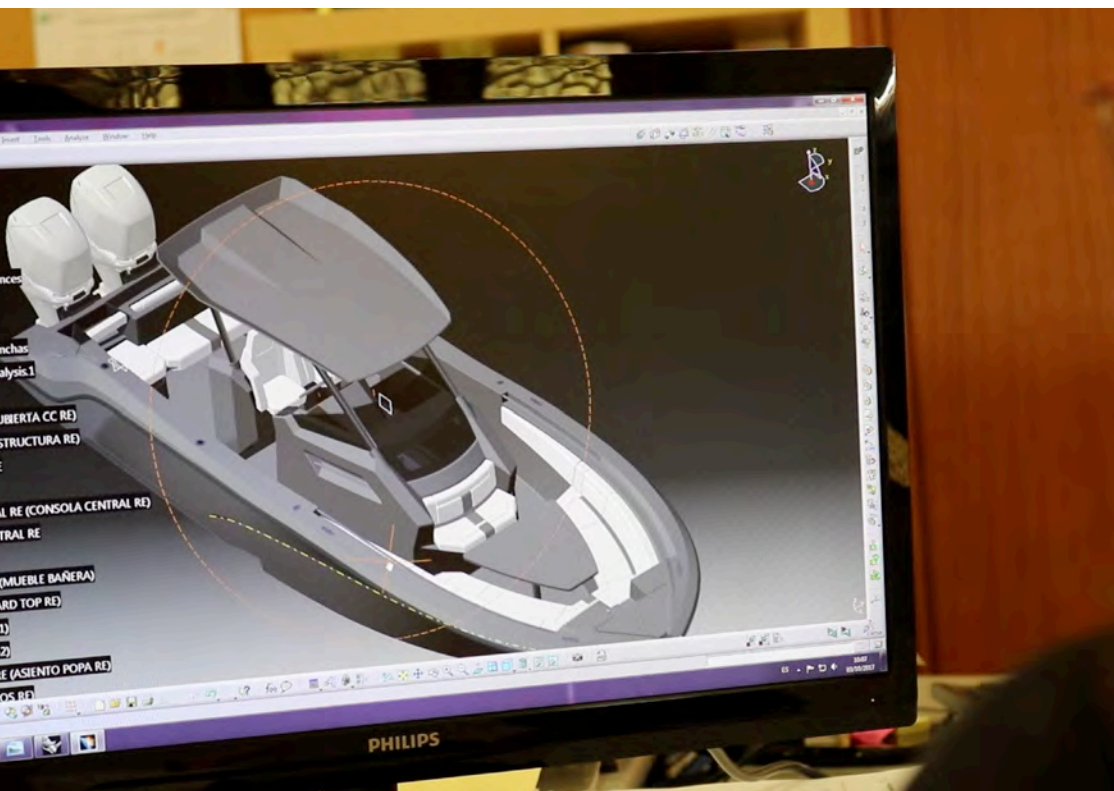
- Improvement of thermal processes conductivity (isothermal) through graphene



Cantilever canopy for the new headquarters of Gazechim.



* This construction would have been impossible with traditional materials like steel or concrete in terms of strength and lightness. winner of the JEC Composites award in Chicago. World's most important fair of Composites



The objective of the afore mentioned Canopy project was the construction of an emblematic building that would reflect the benefits of composites by the means of structures of three-dimensional shapes and double curvatures that were self-supporting, giving the illusion to be held in the air.

This construction would have been impossible with traditional materials like steel or concrete in terms of strength and lightness. This project opens a new window of opportunities in the use and design of composite applications in the construction of buildings.

GRAPHENANO ONE BOAT

Graphene Additive improves the mechanical properties of composites, reduces the amount of material used, wear reduction, increases the durability of the vessel, requiring a minimal maintenance. As a consequence, Graphenano One is lighter, faster, has lower water resistance, less consumption and guarantees greater stability and safety.

Graphenano
COMPOSITES




CompoGraph
GRAPHENE RESIN

Nanotec Composite signs for signaling and road safety,

- Result of a collaborative project between Graphenano Composites and Tecnival, Spanish leader in road, railway and airport safety
- Signs with CompoGraph resin plus graphene nanotechnology, = increase of mechanical properties: resistance to traction, compression and shear
- Substantially lighter compared to steel or aluminium signs
- First contract for traffic signs with the Spanish government





Graphenano
DENTAL

























G-CAM

Graphenano Dental: Use of nanotechnology in the dental sector.

- Graphene nanoreinforced biopolymers for drilling using CAD/CAM technology
- These G-CAM discs are especially designed for permanent dental structures
- Available in different chromatic crowns with extremely natural aesthetic appearance
- Resolving the customary mechanical, physicochemical and biological failures of materials currently used in the sector



Comparison of dental solutions

Types of prostheses / material	PMMA	Metal	Zirconium	Lithium disilicate	Resin + graphene
Individual crowns					
Bridges of up to 3 pieces	-			-	
Bridges of more than 2 implants	-		-	-	
Settings		-	-		
Veneers	-	-			
Complete prostheses		-	-	-	
Direct rehabilitations and implants		-	-	-	

Material properties

Elastic modulus	>3200 MPa
Bending strength	>140 MPa
Surface hardness	88 Shore
Water absorption	4 µg/mm³
Residual monomer	<0,004 %





2. BENDING TEST RESULTS

- A. The Bending test could be said to be the most fundamental test of all the tests that can be performed on a material, and this is also due to the entire standard that it already has behind it.
- B. The test itself consists of exerting pressure at 3 points on the specimen, until the material breaks.
- C. DIN en ISO 178, the machine used is a Zwick Roel Z100, with a preload: 0.1 MPa, flexural modulus speed: 1 mm / min and test speed: 1 mm / min

Nano Composite polymeric resin oligomero amine modified acrylate

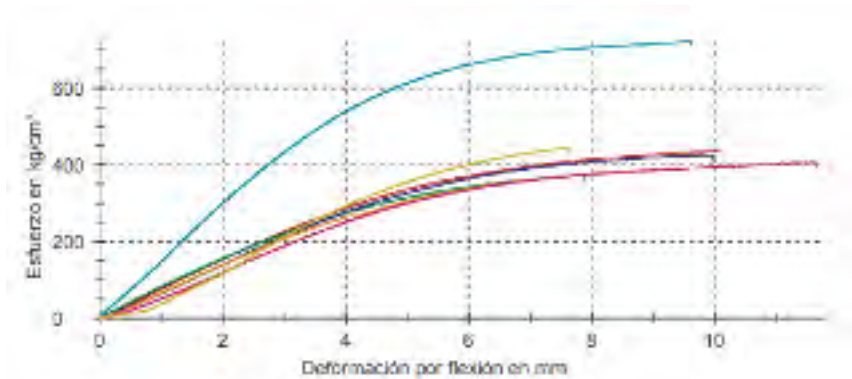


Figura 8. Flex test in different specimens of the nano composite

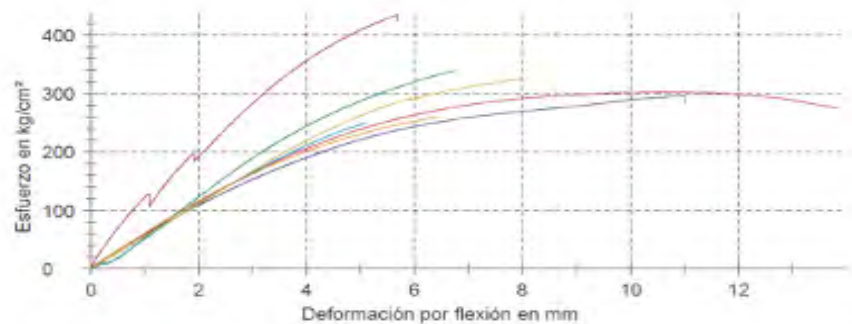


Figure 9. Strain Stress Curve. Bending test

For the Bending test, the resin is without graphene and with X% graphene

Specimen	Elastic Modulus	Resistencia
1	835	39.8
2	925	39.2
3	929	36.5
4	957	41.7

Table 1. Pure amine modified acrylate oligomer resin specimens

Specimen	Elastic Modulus	Resistencia
1	976	42.8
2	989	43.6
3	1950	70.9

Table 2. Specimens of oligomer resin amine modified acrylate % wt

GRAPHENANO MEDICAL CARE RESEARCH & BUSINESS INTERESTS



COSMETICS



METABOLIC HIGH PREVALENCE DISEASES



RENAL AND HEPATIC HIGH PREVALENCE DISEASES



TISSUE REGENERATION

Descubre lo natural

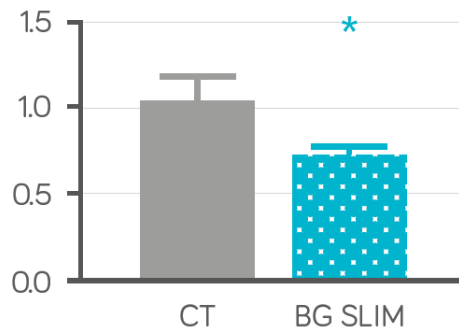


AcquaGraph

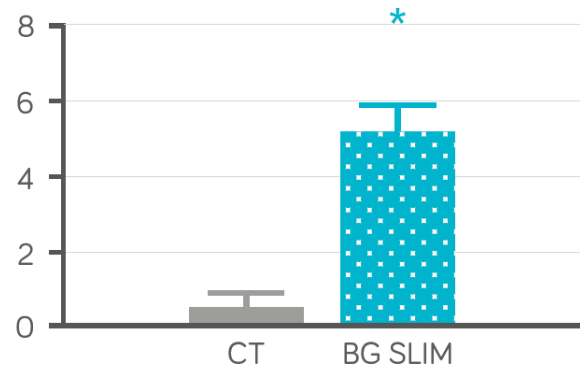
BIOGRAPH SLIM MODIFIES THE DIFFERENTIATION CAPACITY OF CULTURED ADIPOBLASTS

ADIPOGENESIS AND TRANS-DIFFERENTIATION MARKERS

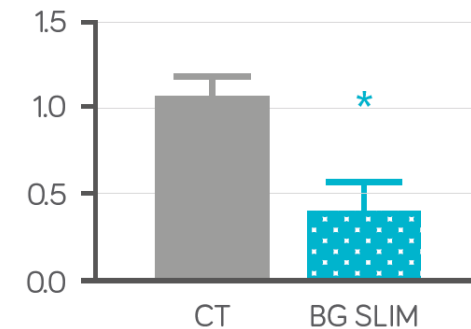
PPAR γ mRNA EXPRESSION
FOLD CHANGE (VS CONTROL)



UCP-1 mRNA EXPRESSION
FOLD CHANGE (VS CONTROL)



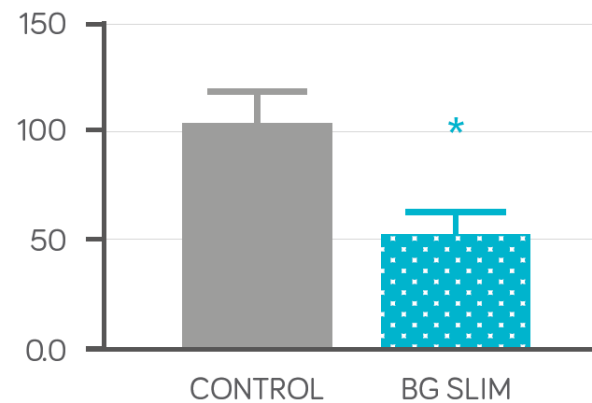
LEPTIN mRNA EXPRESSION
FOLD CHANGE (VS CONTROL)



BIOGRAPH SLIM REDUCES FAT STORAGE IN FULL DIFFERENTIATED ADIPOCYTES

CELLULAR TRIGLYCERIDE STORAGE

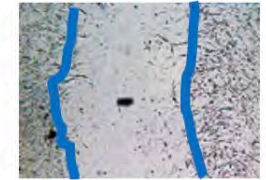
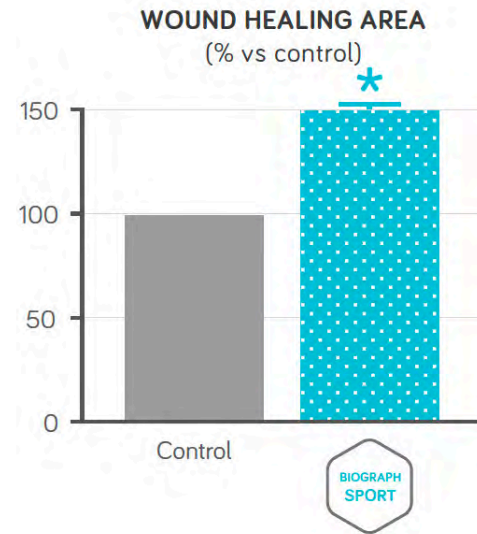
ADIPOCYTES
DE-DIFFERENTIATION
% VS CONTROL



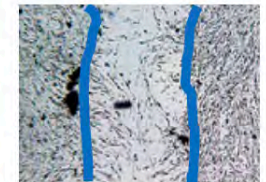
BIOGRAPH[®] SPORTS AS MUSCULAR REGENERATIVE



MYOTUBES
(FROM C2C12 MYOBLAST LINE)



Control



Biograph sport

Further research and tests shall still be carried on.

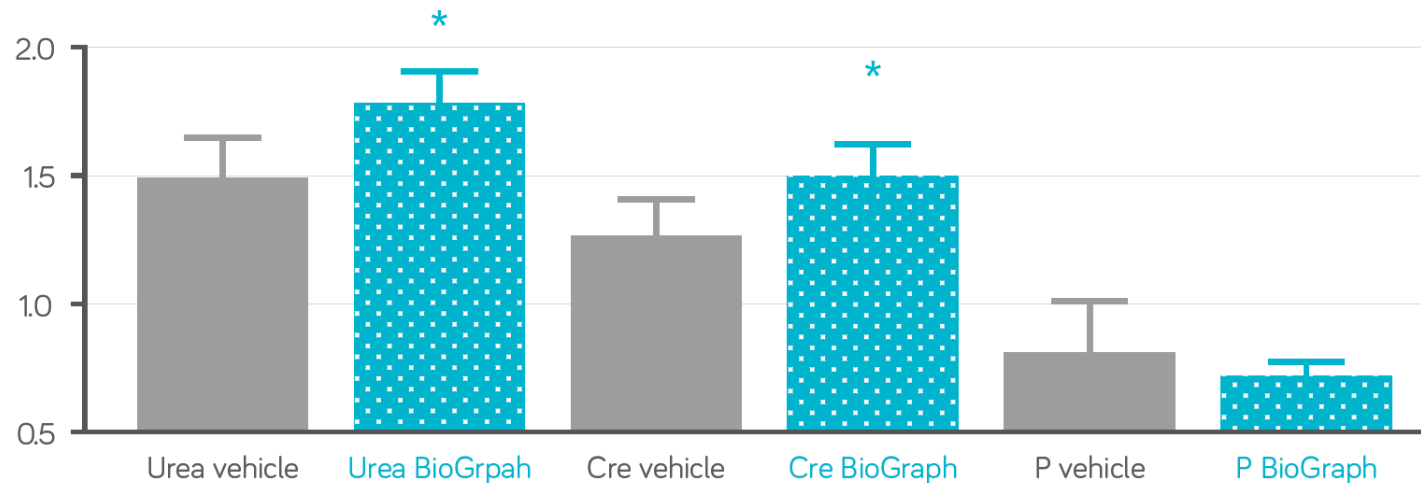
Preparation of the registration dossier will take time and registration by the local health authorities is a long process due to the fact that it will be a prescription product.

BIOGRAPH-1

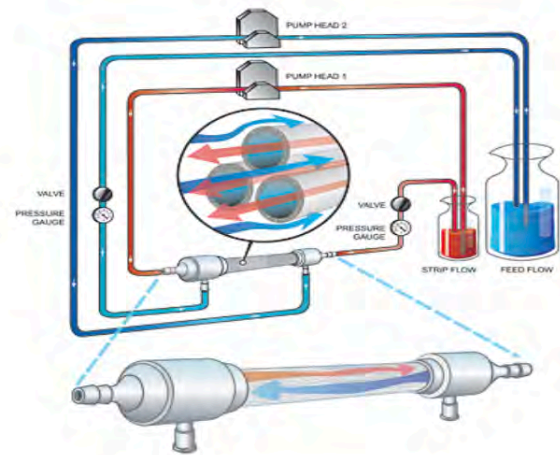
IN THE DIALYSIS LIQUID INCREASES THE DIALYSIS EFFICIENCY

DIALYSIS EFFICIENCY

Blood-like serums were formulated with renal toxins (300 mg/dl urea, 10 mg/dl Cre and 6 mg/ml P). After 15 minutes of dialysis through a commercial dialyzer using the dialysis liquid formulated without (vehicle) or with the product, the dialysis efficiency was determined ($K_{xt}/v = -\ln(x_f/x_i)$). The values are represented as mean \pm SEM. * = $P < 0.05$ vs. control, value considered statistically significant.



RENAL AND HEPATIC HIGH PREVALENCE DISEASES

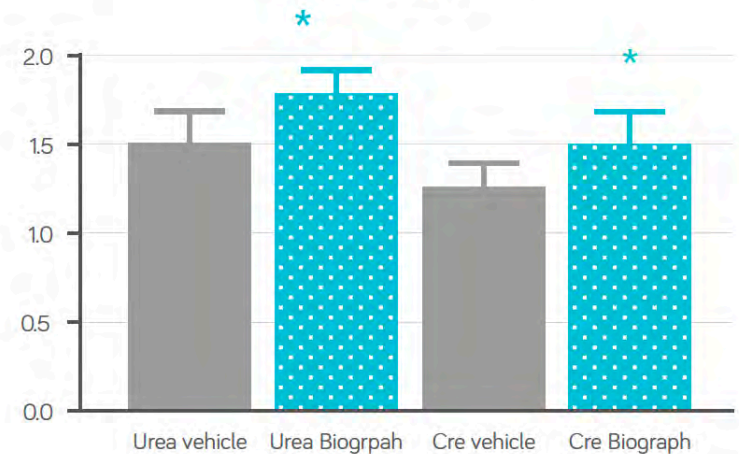


BIOGRAPH
1



BIOGRAPH® IN THE DIALYSIS LIQUID
INCREASES THE DIALYSIS EFFICIENCY

15 MIN DIALYSIS LIQUID EFFICIENCY
($K_{xt}/v = -\ln x_f/x_l$)



Further research and tests shall still be carried on.

Preparation of the registration dossier will take time and registration by the local health authorities is a long process due to the fact that it will be a prescription product.

APPLICATIONS WORKING TO GO

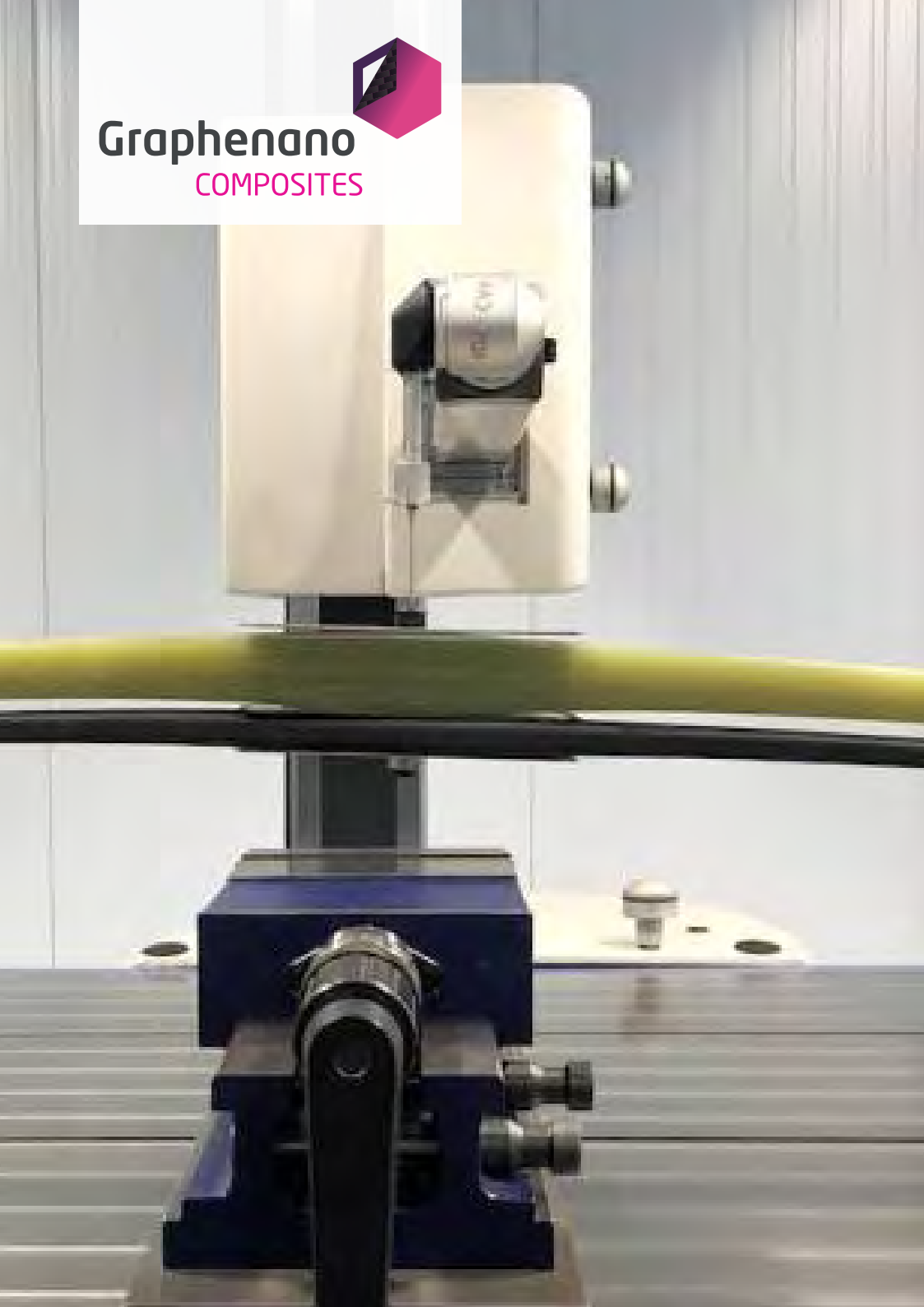


Graphenano
COMPOSITES



CompoGraph
GRAPHENE RESIN

IM-VISION® ASV1 coating is a nano-functionalised polysiloxane technology which creates an increased level of surface hardness to the lens which it is applied. This increased surface hardness results in a dramatically lower level of surface scratching and therefore a lower level of light diffusion, meaning that the lens retains near perfect optical quality for an extended duration compared to standard coated lenses.



Manufacture of automobile springs

- Project with MBHA Hispanoamericana
- Prototype exceeds characteristics of existing products.
- Proven economic profitability





Smart**FLOOR**

GRAPHENE ADDITIVE

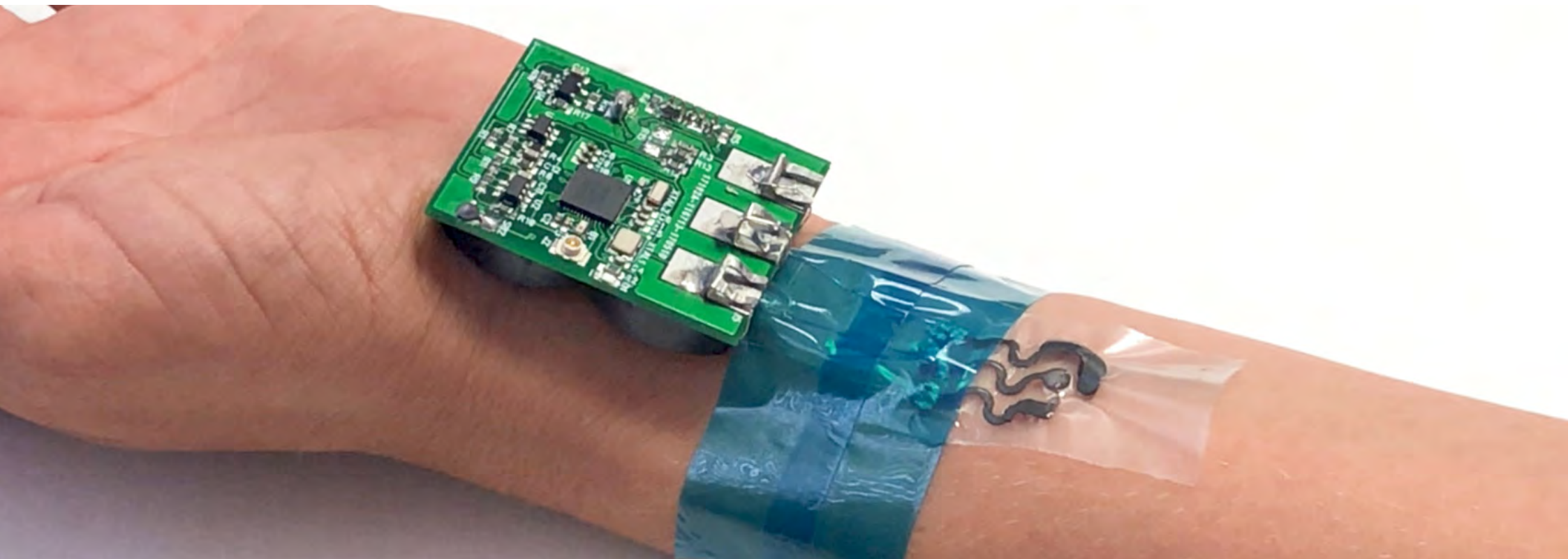
Graphene additives for the manufacture of artificial stones

- For use in kitchen countertops and finishing
- Replacement of Silestone (health hazards by silicosis from exposure and inhalation of silica microparticles).
- EcoStone Material: -Substantial Savings in raw material and machinery
- No further investment in new infrastructure.
- Total cost of production: less than 80% compared to products based on polyurethane resin.

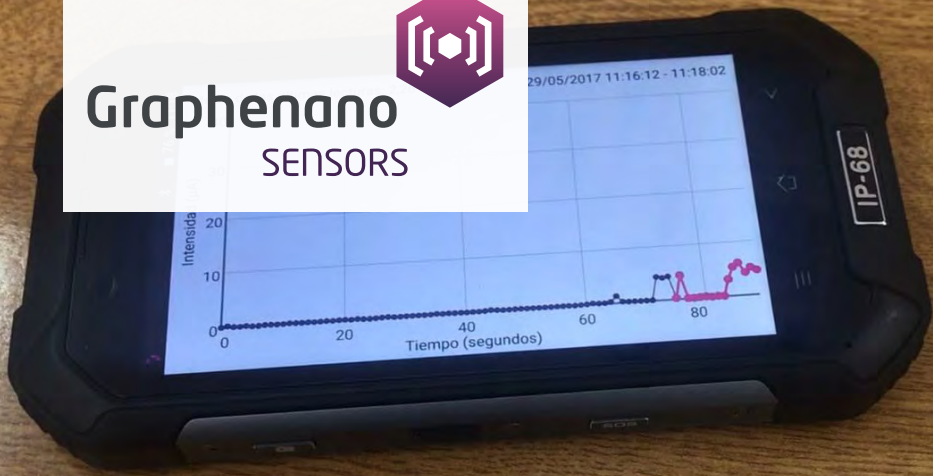


Graphenano Sensors has developed, in collaboration with the University of Alicante, an electrochemical biosensor based on graphene for the quantification of glucose.

The biosensor is fixed on the skin as a “tattoo” and can measure the glucose index on site through human sweat, which will serve to diagnose diseases as common and important as diabetes or hypoglycemia more easily and quickly, avoiding extractions of blood samples.



Graphenano
SENSORS



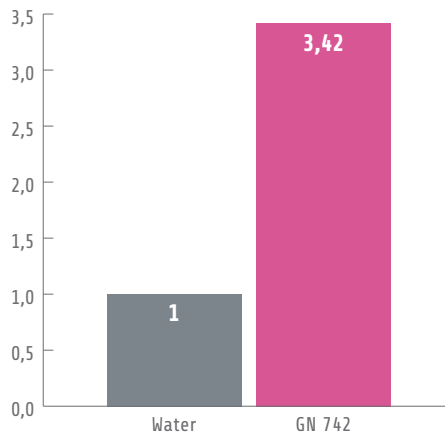
GLUCOSE BIOSENSOR

Development of an electrochemical biosensor based on graphene that can be fixed in the skin for glucose quantification in situ in samples of human sweat.

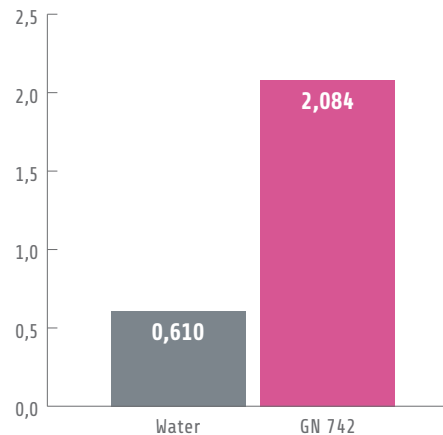
COOLING LIQUID WITH GRAPHENE

IMPROVEMENTS IN REFRIGERATION AND THERMAL CONDUCTIVITY

Relative conductivity



Conductivity (W/mK)



Thanks to our **Heat Transfer Fluid with graphene**, we achieve more efficient cooling and thermal conductivity than with conventionally used heat transfer fluid, improving thermal performance. The Heat Transfer Fluid with graphene can be used in different sectors, such as



Automotive

Reduction of around 40% of cooler surface (cooling system).



Industry

Energy savings in cooling and heating processes, doubling current energy efficiency.



Conditioning

Energy system based on geothermal could be optimized, double their performance. This optimization would be carried out on any system that uses thermal fluids.



ADDITIVE MANUFACTURING GLASS CONTAINERS



HIGH ADVANCE TEXTILE ADDITIVE

TECHNOLOGY PARTNERSHIP

Graphenano group has reached partnerships and contracts with world's leading technological companies.



PARTNER UNIVERSITIES

Graphenano group collaborates on a number of its developments with several Spanish universities.





Graphenano
nanotechnologies

graphenano