

G-CAM

Graphene nanoreinforced biopolymer disc
for CAD/CAM drilling



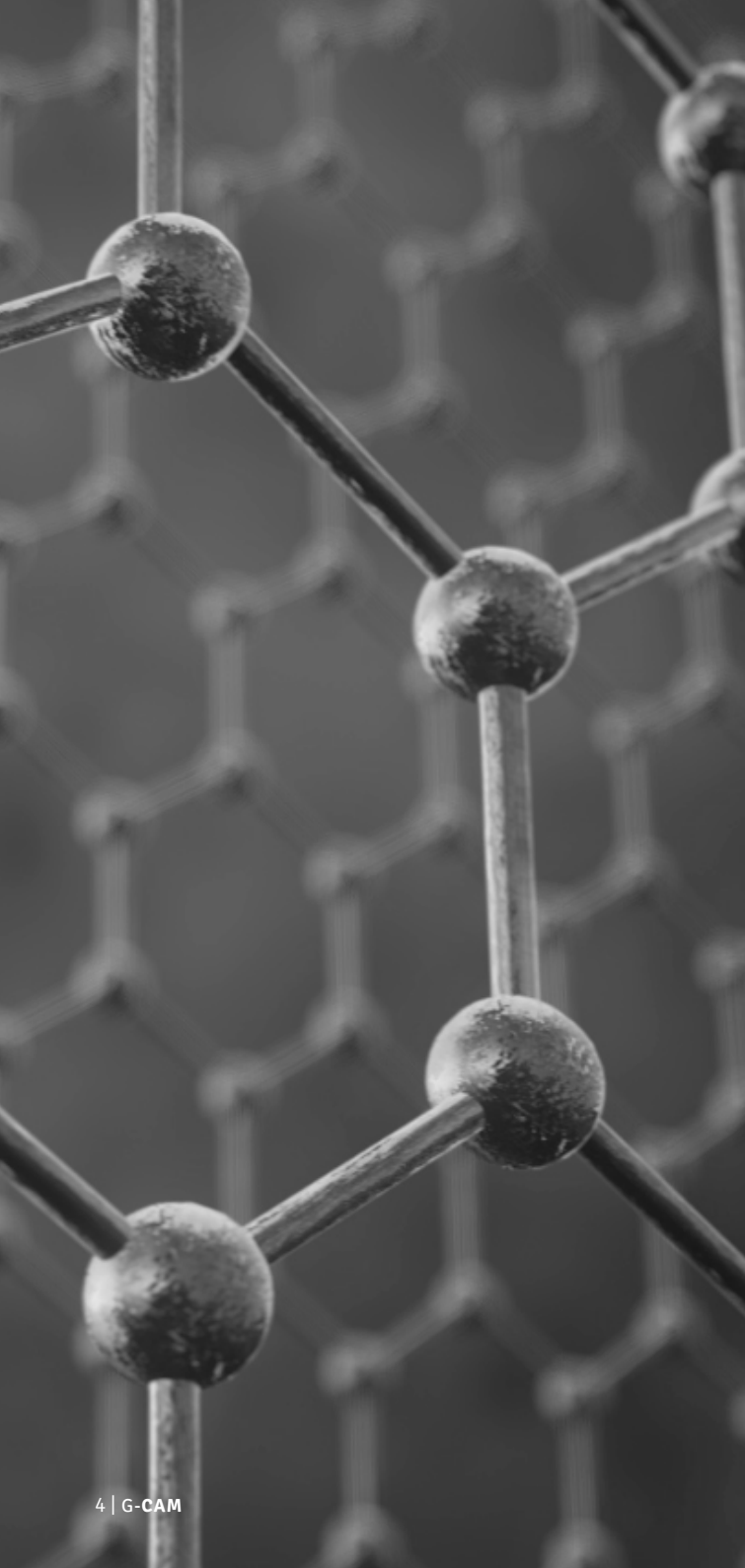


Graphenano Dental is committing to the use of nanotechnology in the dental sector by creating biological use graphene nanoreinforced biopolymers for drilling using CAD/CAM technology.

The **graphene nanoreinforced biopolymer G-CAM disc**, especially designed for permanent dental structures, is available in different chromatic crowns that have an extremely natural aesthetic appearance, as well as resolving all the mechanical, physicochemical and biological failures of the rest of the materials currently used in the sector.

Graphenano Dental belongs to Graphenano, a group of companies dedicated to the integration of graphene for multiple uses, and a leader in the production of different types of nanostructures on an industrial scale.





Resina + Grafeno

Autopolymerising resins

Acrylic resins are hard, fragile and crystalline polymers, which are used as thermostable materials, given that, after they have been cured, they cannot be changed or moulded.

Autopolymerising resins with a Poly (methyl methacrylate) (PMMA) are the most used type of material in dental laboratories. However, they have a low impact resistance and a low transverse and flexion resistance, which stems from the formation and is liable to cracks spreading when it is submitted to mechanical forces.



Graphene

Graphene can be described as a two-dimensional material in which the carbon atoms are joined through sp^2 links to make a flat sheet with a structure similar to a beehive.

Graphene's properties make it a material with big potential for the manufacture of other compound materials. Amongst its principal properties are its high thermal and electrical conductivity, its high traction resistance, its low density and its low coefficient of thermal expansion. Furthermore, since it is carbon, graphene is ecological and recyclable.

The incorporation of graphene into autopolymerising acrylic resin is an innovating strategy to improve its mechanical properties, simultaneously increasing the elastic modulus as well as the tenacity, reducing the appearance of cracks and/or the spreading of them as well as decreasing the shrinkage rate during polymerisation.

Graphene is the ideal candidate to improve the performance of autopolymerising acrylic resins for dental use, not only due to its high traction resistance, coefficient of thermal expansion, high capacity for absorption and lubrication, flexibility and high surface area, but also for its high weight to resistance ratio.

Resin polymerisation with graphene

One of the principal advantages of graphene is that even in small quantities its inclusion can cause big changes in the mechanical and physicochemical of the material to which it is added, as long as it is well dispersed and produces a good reaction with the original material.

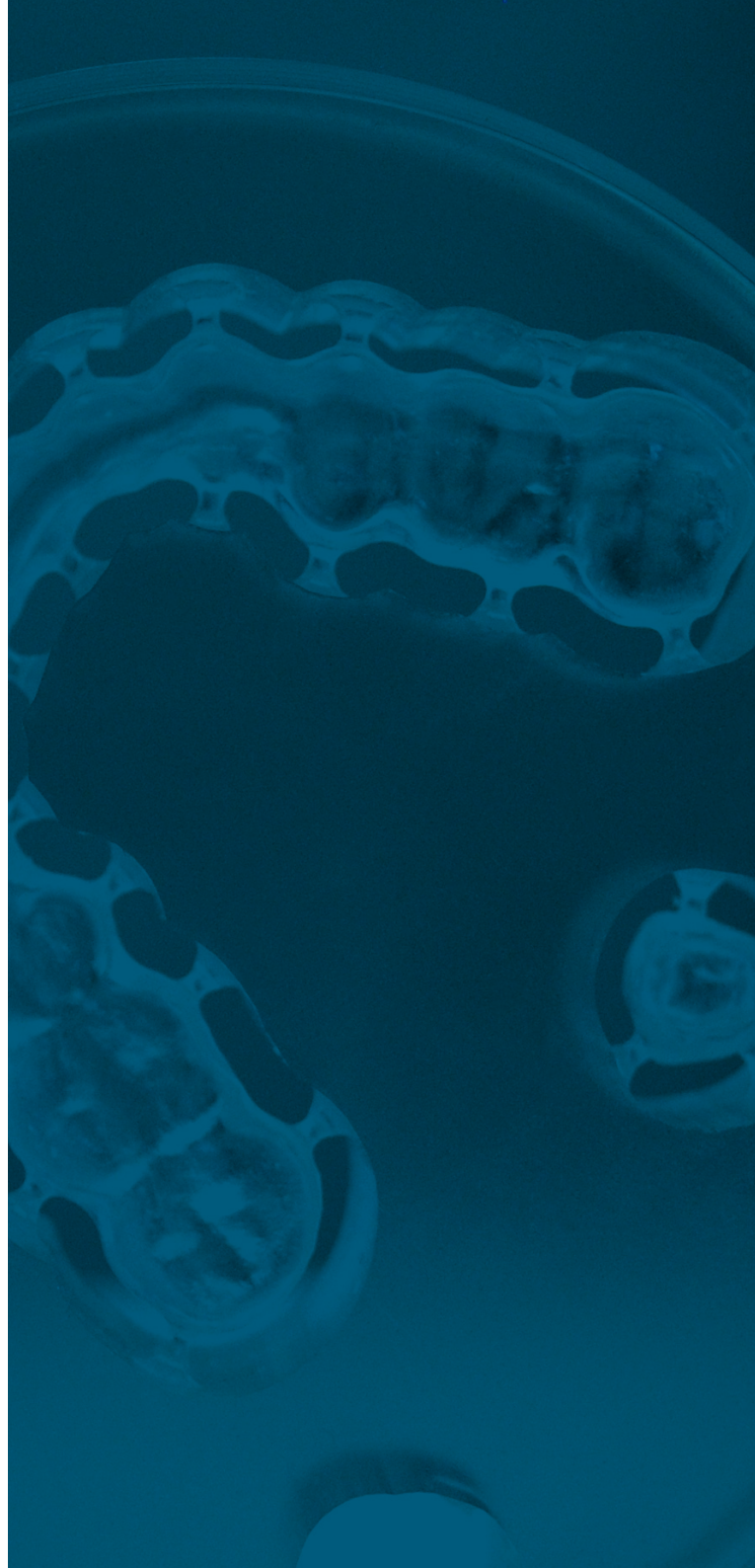
Given that graphene is a good thermal conductor and that the process of post-polymerisation of the acrylic resin requires heat complete it, the addition of graphene allows for a higher polymerisation conversion rate.

Compared with conventional polymer materials, biopolymers nanoreinforced with graphene have a higher modulus and specific resistance thanks to the distribution of tension between the structures, meaning that they are capable of withstanding tensions practically without suffering deformations. The union between the nanoreinforcements and the original polymer is one of the main aspects that explains the increase in mechanical properties in this type of compound material.

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Properties

The acrylic resin biopolymer nanoreinforced with graphene from Graphenano Dental complies with all the necessary requisites to be the ideal material for prosthetic works with CAD/CAM technology.





Physical properties

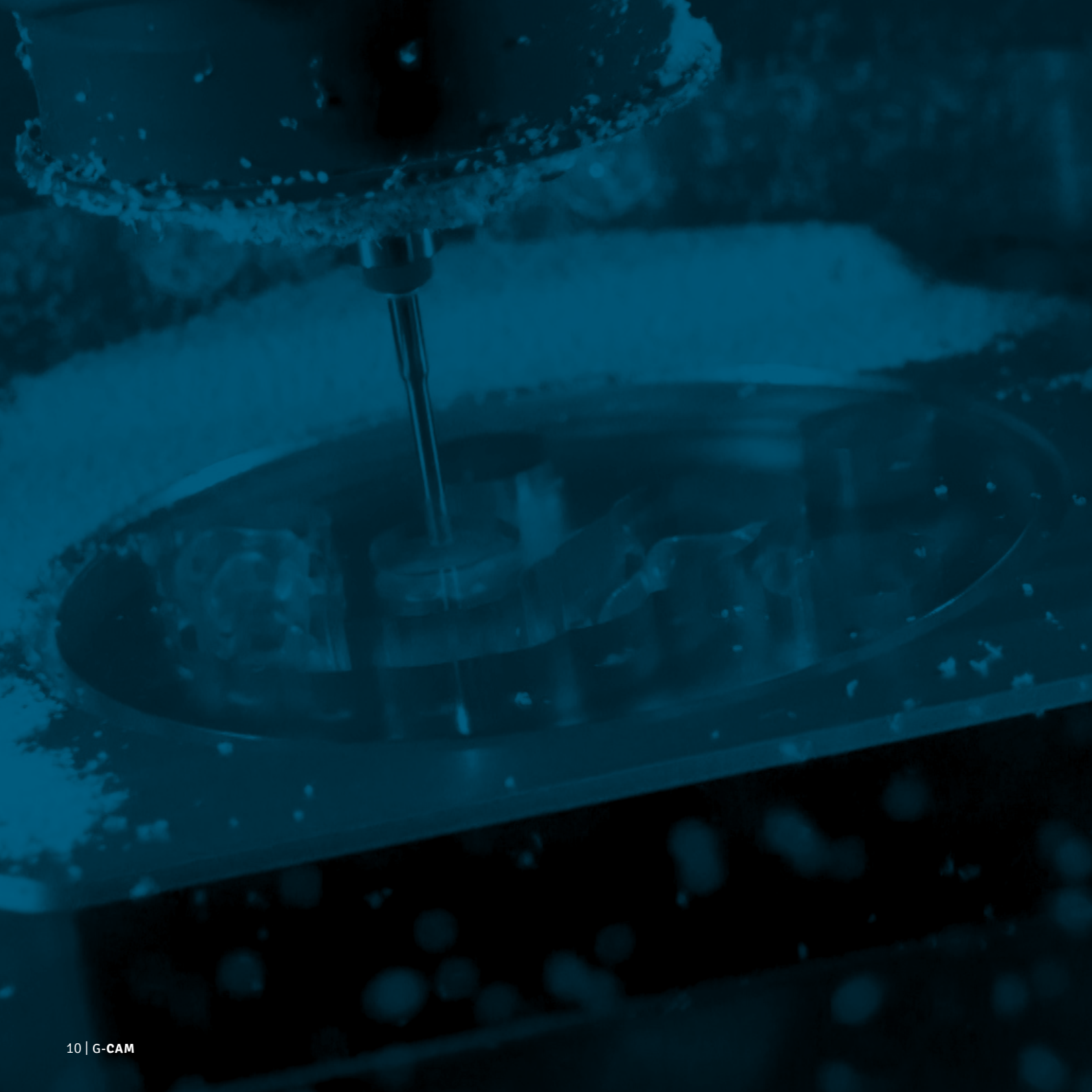
- It has a similar appearance to oral tissue, ideal for areas that are more visible. The **G-CAM** disc has a **wide chromatic range**, even within the same piece, making it look extremely natural.
- It has a **high glass transition temperature (T_g)** that prevents it from softening and distortion during use and cleaning. It is necessary to take into account that while the normal temperature of the mouth is 32-37°C, the consumption of hot drinks (that can be up to 70°C or more) as well as cleaning the prosthesis in or boiling water expose the materials to higher temperatures.
- Graphene **improves the dimensional stability** in polymers for dental use, which allows the dental prosthesis to maintain its shape over time. This does not only influence the thermal softening mechanisms but also the internal stress relief, the incomplete polymerisation of the material or the water absorption.
- Thanks to graphene, **G-CAM** improves its resistance in relation to weight. **The material has a low density** making the prosthesis lightweight.
- The material also has **high electrical conductivity** to maintain a healthy oral mucous and to react normally to hot or cold stimuli.
- It is **radiopaque**; therefore, allowing radiographic diagnostics to be used on patients that have been involved in accidents or that may have digested or inhaled part of the prosthesis.
- A **translucent** material allows high transparency to imitate the natural aesthetic of the tooth, but also allows us to create opaque colours to avoid showing dead teeth or metal pins.
- The material is **totally waterproof and stable** and does not allow plaque build-up, furthermore, due to its closed pores there is no dirt build-up or discolouring.
- It does not require an interface process during the make-up of the dental piece. There is no danger of it breaking or chipping, since the enamel is resistant to micro stresses.



Mechanical properties

- The **polymer presents a high elastic modulus**. It also has a **high elastic limit** to ensure that the tensions generated during biting and chewing do not cause permanent deformations. The combination of these allows the prosthesis to be manufactured in smaller sections.
- Fractures in prostheses often occur due to stress mechanisms, in which the accumulation of small flexion tensions leads to, after a period of time, the formation of small cracks which spread and give way to the fracture. With graphene resin, this does not happen since it has a **high deformation resistance and stress limit, thus avoiding the formation of cracks**.
- The graphene also has a **high impact resistance**, which is useful for removable prostheses, where there is the possibility of damage or breakage if they fall onto a hard surface.
- The **G-CAM** disc has a **high-abrasion resistance** that avoids excessive erosion from cleaning or eating. The hardness numbers for acrylic resins are relatively low especially when they are compared with certain alloys used in dentistry, which makes them predisposed to abrasion from certain foods, cleaning products, etc. With the integration of graphene, the **hardness is increased** and erosion is avoided.
- As well as being flexible, the stomatognathic system suffers from volumetric changes over time. The **flexibility** of the **G-CAM** and its insertion with photopolymerisable materials make it the best option to ensure that your treatment is durable.
- The versatility of our products allows them to be used in the majority of dental treatments, minimising the margins of error and ensuring that the treatment is **long lasting**.
- The productive system that we use at Graphenano Dental ensures that the company's products comply with all the technical and sanitary requisites that are assessed through an exhaustive **quality control procedure using ultrasound (Graphenano Ultrasonic Tester)**.







Chemical properties

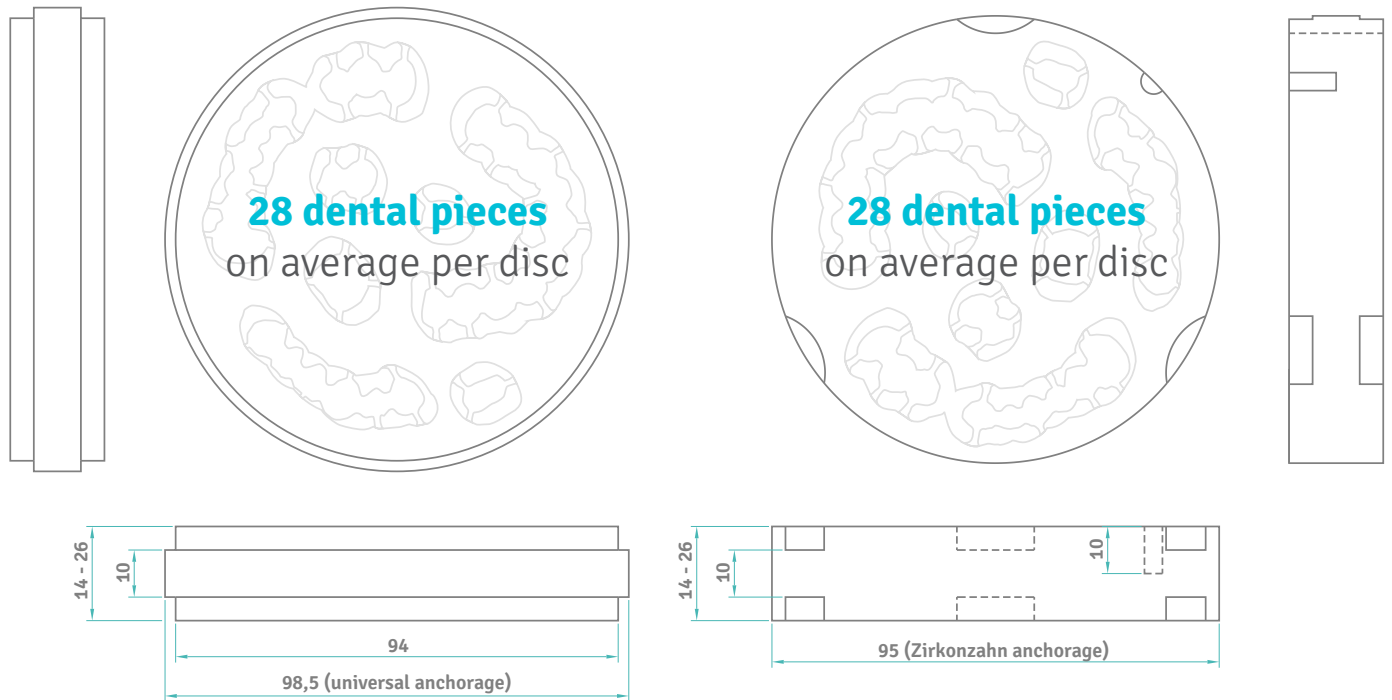
- The **G-CAM** disc is chemically inert.
- It is insoluble in oral fluids.
- It does not absorb water or saliva, meaning that mechanic properties are not altered and it is completely hygienic.
- It does not allow for the phenomenon of bimetallism.

Biological properties

- The cured material is not an irritant or toxic for the patient. The **G-CAM** disc has passed the cytotoxicity and genetic tests carried out at the University of Alcalá and by the Valencian Institute of Microbiology (IVAMI).
 - In vitro cytotoxicity test. ISO Standard 10993-5:2009.
 - Reversion of Bacterial Mutations Test. ISO Standard 10993-3:2014 and OECD 471:1997.
- Antiallergic.
- Bacteriostatic. Graphene does not allow the growth of bacteria or mould.

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Characteristics



Graphenano Dental offers a wide chromatic catalogue, which guarantees comprehensive solutions. The **G-CAM** colorimetry, based on the VITA classic shade guide, is not only limited to intermediate colours, but also allows for more shades through the make-up of photopolymerisable surfaces in the laboratory.

G-CAM is available in the following dental colours: BL2, A1, A2, A3, A3'5, B2 and C2, in addition to transpa and pink.

The **G-CAM** disc comes in two different formats:

- **G-CAM Monochroma**, single colour.
- **G-CAM Multichroma**, a unique wide chromatic spectrum based on natural colours with high translucence.

The thickness of the **G-CAM** disc can be 14, 16, 18, 20, 22, 24 and 26 mm.

Material properties





















Elastic modulus	>3200 MPa
Bending strength	>140 MPa
Surface hardness	88 Shore
Water absorption	4 µg/mm ³
Residual monomer	<0,004 %

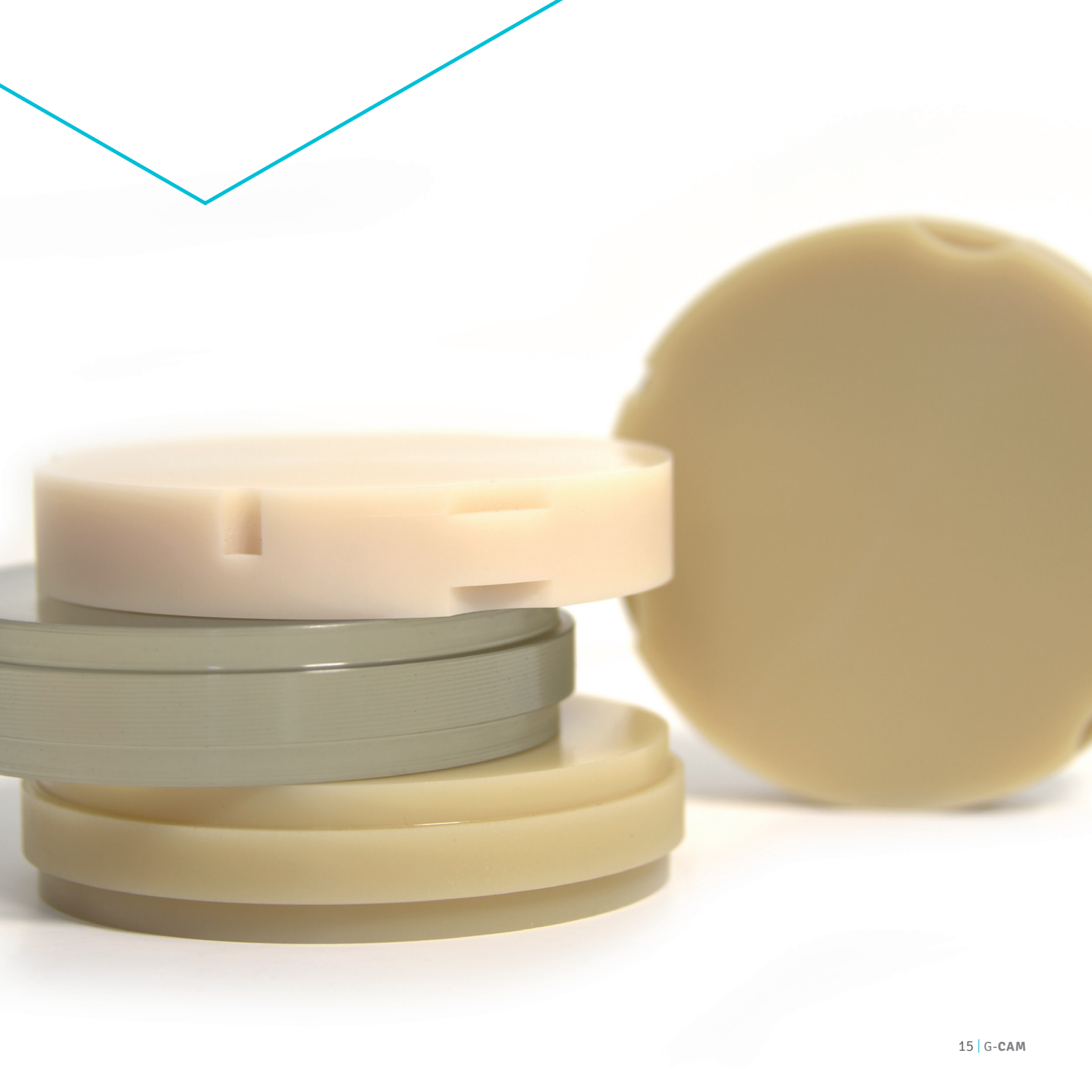


* The shade of the colour in the catalogue may differ from the actual colour.

Comparison of dental solutions

Under material

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		-	-	-	



What is Multichroma format?

Multichroma format must not be mistaken with the multilayer format.

Multichroma format is a new concept created by Graphenano Dental in which the transmission of background colours of dental restorations is simplified with the intention of achieving the naturalness of the restorations, imitating optical effects of natural teeth.

The regular version that the sector offers is a multilayer format of horizontal setup. This format generates “band effects” of transition between layers, which worsen in situations of non-harmonic anterior groups and in speed curves of posterior sectors. By contrast, the configuration of natural structures is

vertical, so the depth and thicknesses create multichromatic light effects. In other words, the solution offered by dental sector is a horizontal colours configuration, while the nature of the tooth is vertical.

As it would be very difficult to obtain an arrangement of vertical layers in a disc format for multiple unit restorations, Graphenano Dental achieves these natural effects through the control of thicknesses with single-layer translucent colours. When the tooth is out of the mouth, the most translucent area is the cervical edge (**Image 1**); but, when the tooth is adapted onto the model, the chroma is enhanced in the cervical area and the most translucent area is now the incisal edge, in the same way as in a natural setup (**Image 2**).

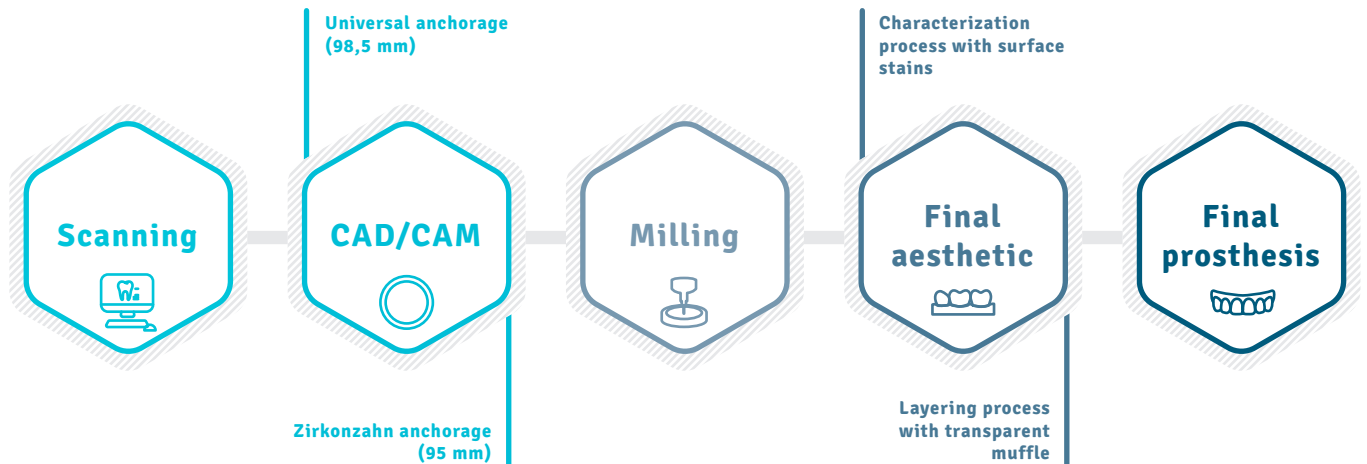


(Image 1)



(Image 2)

Process in laboratory G-CAM



Graphenano Dental, dedicated to the development of graphene disks for CAD/CAM, is committed to delivering the best dental solution to prostheses' patients worldwide, guaranteeing them more aesthetic, comfortable and durable smile, by using the most advanced technology (graphene nanotechnology) together with efforts of dental experts, technicians and dentists.

Proceso de trabajo Disco G-CAM

Process in laboratories

Cleaning the graphene crown



Blast with
aluminum oxide

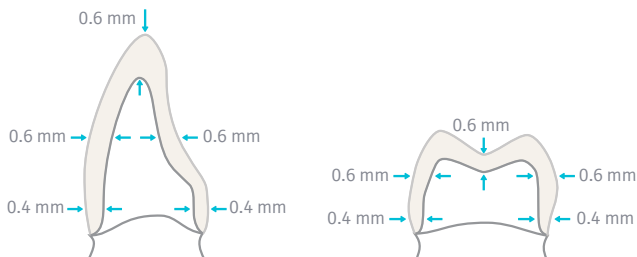


Steam clean



Dry with pressured
air

Wall thickness in restoration



See instructions of use for the wall thickness suitable in restorations (e.g. veneers, inlays and onlays).



Process in a clinic

Cleaning the prepared tooth



Blast crown



Remove excess



Clean with ethyl alcohol
and let dry (60 s)



Clean and isolate the
tooth with a rubber
dam



Apply etchant gel (at
37% of phosphoric
acid)



Rinse thoroughly
with water and
aspirate



Apply silane and
let dry (30 s)

Cementation of the crown



Apply dual
cement*



Firmly press and
remove the excess of
cement



Polymerize (30 s)
and remove the
excess of cement

*It is recommended to use Fuji PLUS, resin-reinforced glass ionomer cement.

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