

Baikowski[®] 



Solution partner for
FINE MINERALS

**NANOFILLER DISPERSIONS
FOR SUPERIOR
DENTISTRY RESTORATIONS
& ENDODONTIC SOLUTIONS**

ZILIGHT[®] (YSZ) & FILYXIO[®] (YbF₃)

YTTRIA STABILIZED
NANO-ZIRCONIA



NANO-YTTERBIUM
FLUORIDE





> Throughout history, the methods for repairing damaged teeth have progressed significantly, transitioning from the use of beeswax in ancient times to the potentially detrimental alloys of the 17th century, and ultimately to contemporary materials such as ceramics, amalgams, and enhanced resin composites.

> **Modern dentistry** has evolved significantly, combining advanced materials science with patient-centered care to meet the growing demands for durability, esthetics, and efficiency.

To meet these expectations, professionals rely on cutting-edge dental composites that encompass a range of innovative products, including nanofillers, functional additives, and advanced opacifiers.

These materials improve every aspect of dental restoration and ease of use, ranging from **wear resistance and mechanical strength to color matching and radiopacity**.

> Mathym®, a Baikowski® Group Company, plays a crucial role in this ecosystem by offering nanodispersions such as yttria stabilized nano-zirconia, nano-ytterbium, nano-yttrium, nano-cerium and nano-calcium fluorides. These nanomaterials enhance the properties of dental composites, enabling dentists to achieve better shading, reduce polymerization stress, and deliver high-quality restorations faster and more efficiently.

1. Nanofillers: The best Choice Among Fillers For Combining Strength & Aesthetic Performance & Mathym® Nano-Offering
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1. Nanofillers: The Best Choice Among Fillers For Combining Strength & Aesthetic Performance

> Dental composite materials have revolutionized the way cavities and other dental defects are restored compared to traditional materials like amalgam or unfilled resins.

> These materials are made up of **a resin matrix and filler particles** made of inorganic materials, with the fillers playing a crucial role in enhancing the physical properties and performance of the composite.

> By precise **tailoring of the filler size and composition**, dental solutions can be providing such as strength enhanced solutions for posterior restorations and natural look solutions for anterior applications. However, combining hardness and transparency has been a challenge until nanotechnology exists.

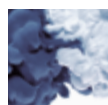


Comparison Between The Different Types Of Fillers

Type of Fillers	Definition	Applications	Advantages	Drawbacks	Combining Aesthetics & Mechanical Properties
Macrofillers	Larger particles (10-50 μm) incorporated into the resin matrix.	Posterior restorations requiring high strength.	High strength and resistance to fracture.	Rough surface texture, prone to staining, less polishable.	**
Microfillers	Very small particles (0.01-0.1 μm) designed for smoother finishes	Anterior restorations requiring high esthetics.	Superior polishability, smooth surface, stain resistance.	Lower mechanical strength, prone to wear under stress.	**
Hybrid Fillers	Combination of macrofillers and microfillers.	General-purpose restorations for both anterior and posterior teeth.	Good balance of strength and esthetics, versatile.	Lower mechanical strength, prone to wear under stress.	****
Nanofillers	Ultra-fine particles (1-100 nm) uniformly distributed within the matrix.	Anterior and posterior restorations, veneers, crowns, and complex restorations.	Excellent polishability, high translucency, superior mechanical strength, reduced shrinkage.	Higher cost, advanced manufacturing required.	*****
Nanohybrid Fillers	Combination of nanofillers and larger particles for optimized properties.	Multi-purpose use in anterior and posterior restorations.	Excellent strength, polishability, and wear resistance.	Higher cost, may require careful handling for layering.	*****

> Nanofillers excel in providing a natural look and smooth finish. With their advanced properties, they stand out as a transformative option, combining **esthetics, durability, and ease of use**, including in complex dental procedures.

Their versatility in adapting to various applications and minimizing the risk of gaps or defects during polymerization further strengthens their position as the go-to material for modern restorative dentistry for all type of resin composites.



Mathym's Offering: The Smallest Nanofillers On The Market



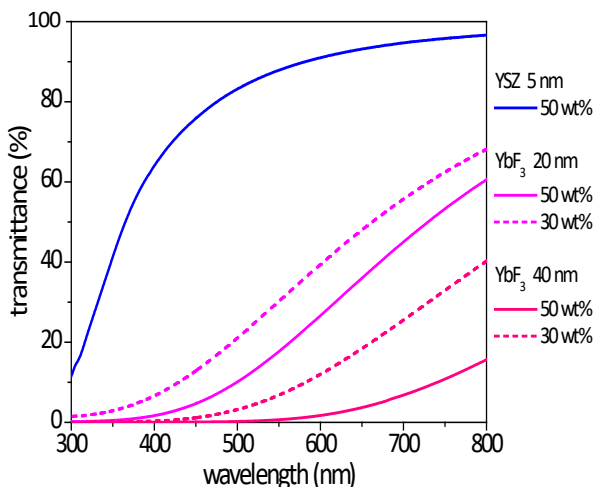
> Mathym® develops very small nanoparticles, specifically designed for incorporation into dental composites. These **advanced nanofillers** serve as radiopacifiers, refractive index and shrinkage modulators, as well as mechanical property enhancers, remineralizing and antibacterial agents.

Additionally, Mathym®'s proprietary functionalization of nanoparticles ensures compatibility with all dental monomers, even at high filler concentrations. This adaptability enables seamless integration into:

- **A Wide Range of Applications:** Suitable for anterior and posterior restorations, veneers, crowns, and inlays/onlays.
- **Technological Compatibility:** Integrates seamlessly with CAD/CAM systems and 3D printing, enabling precise and customized restorations.

> Mathym's portfolio includes **YSZ, YbF₃, and YF₃ nanodispersions**, offering outstanding performance:

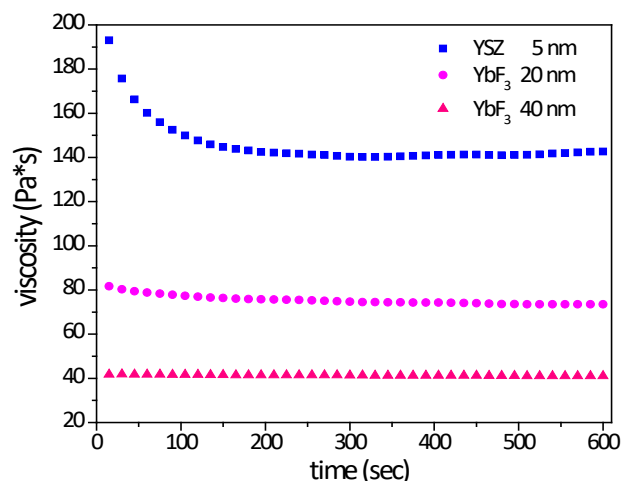
> Transmittance measurements of TEGDMA monomer filled with Mathym® nanofillers illustrate permeability for blue light over 10 mm optical path.



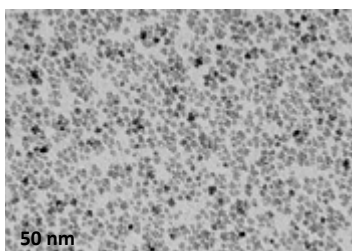
Nanofillers key Benefits

- **Very Small Particle Size:** Below 100 nanometers, enabling precise packing within the resin matrix.
- **Uniform Distribution:** Ensures mechanical properties and wear resistance across the composite.
- **Homogenous Dispersion:** Reduces agglomeration, enhancing polishability, translucency, and strength.
- **Low Viscosity:** Maintains excellent handling properties even at high nanoparticle concentrations.
- **Improved Depth of Cure:** Enables deeper polymerization. The better fit between particles and matrix ensures complete and durable composite restorations, as well as reduce the risk of secondary caries.

> Viscosity measurements of dispersions of 50 wt% nanofiller in UDMA show usability of the obtained mixtures in formulation process.



Nano-Zirconia Range



> With its average particle size ranging from **5 to 20 nm**, zilight® is the smallest YSZ nanoparticle on the market that can be doped with yttrium or ytterbium to meet dentistry restoration needs.

Among its benefits, the zilight® range offers:

- **Very high isotropic refractive index** ≥ 2.10
- **High transparency and low viscosity** at high particle loading

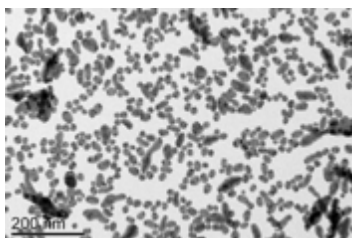
These properties enable the production of translucent and opalescent ceramics with excellent mechanical strength and fracture toughness.

Read more about [zilight®](#) in our dedicated article.



Nano-dispersions (Typical values)	zilight® (YSZ)
Chemical formula	ZrO ₂ - 1 to 10 mol% Y ₂ O ₃
Crystal structure	Tetragonal
Morphology	Nearly spherical
Average Particle Size (nm)	5 - 20
Refractive index	≥ 2.10
Dispersion solid content (wt.%) <i>Depending on dispersion medium</i>	Up to 70

Nano-Ytterbium Fluoride

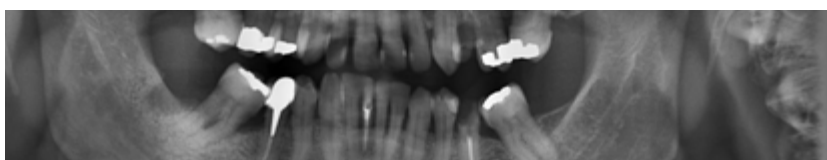


> Mathym's YbF₃, filyxio®, with a particle size of just 20 nm, offers an unmatched combination of functionality, durability, and esthetics for restorative dentistry, including:

- **High radiopacity**
- High translucency & color stability
- Refractive index around 1.53
- Enhanced flexural strength

> Our nano-dispersions are available dispersed in a **variety of solvents & resins:**

- Water
- Alcohol
- Acetone
- Methacrylate-based dental resin
- Custom solvent

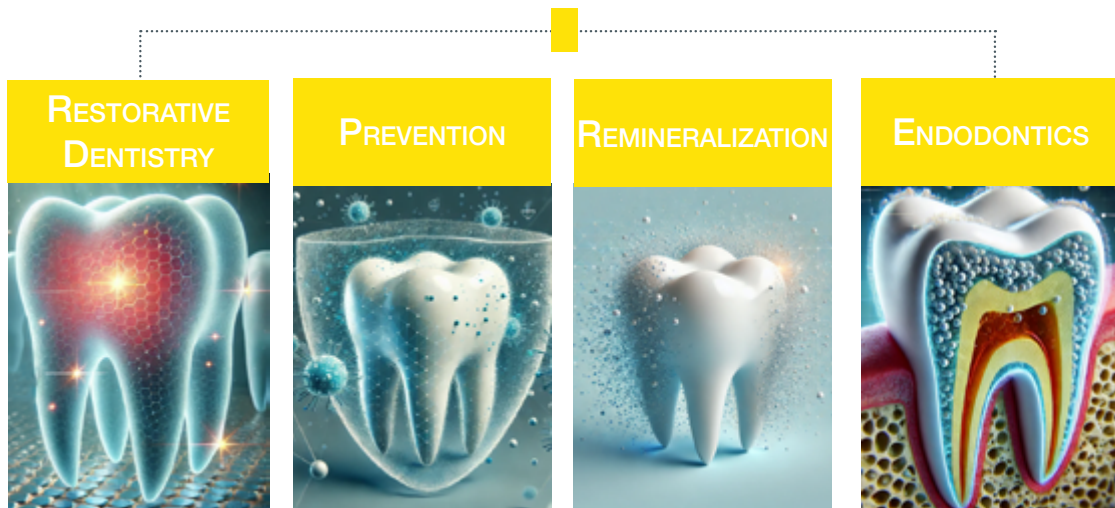


Nano-dispersions (Typical values)	filyxio® YbF ₃
Chemical formula	YbF ₃
Crystal structure	Orthorhombic
Average Particle Size (nm)	20 & 40
Density* (g/cm ³)	8.2
Refractive index*	1.53
Dispersion solid content (wt.%) <i>Depending on dispersion medium</i>	Up to 70

Nano-dispersion Characteristics	Example 1	Example 2
Nanoparticles	YbF ₃	YbF ₃
Size	20 nm	40 nm
Monomer	UDMA	UDMA
Solid content (wt.%)	30	50
Viscosity (Pa.s)	50	41
Shear rate (s ⁻¹)	10	10
Radiopacity (mm Al)	2.5	5.4



2. Nanofillers Main Applications



3. How Mathym's Nanofillers Meet Good Looking & Radiopacity Restoration Needs

> Nanofillers, with their ultrafine particle size and uniform distribution, as well as homogenous dispersion within the resin matrix, allow composites to be applied in thinner layer and enable minimally invasive techniques. With these advanced, user-friendly nanomaterials, clinicians can achieve predictable, durable, and highly aesthetic results, but also ensure accurate diagnoses. By meeting both **patient expectations and clinical performance** standards, these innovations elevate the overall treatment experience.

Dental Shading & Opacification for Patient Natural-Looking Teeth

> Although restorative materials are available in a variety of shades and often include shade guides, achieving a lifelike appearance requires a careful **balance between opacity and translucency**. The perceived color of a tooth is determined by three key factors:

- **Hue:** The basic color of the tooth (e.g., yellow, brown, or gray).
- **Chroma:** The saturation or intensity of the hue.
- **Value:** The brightness or darkness of the color.

> The optical properties of nanofillers, including light scattering and refractive index matching, enable **precise color matching**. These properties can be further optimized by combining nanofillers with shade

modifiers, ensuring seamless integration with natural dentition.

> To enhance depth and realism, opacifiers may be incorporated, and clinicians apply layering techniques to mimic the natural structure of a tooth:

- **Dentin Layer:** This foundational, more opaque layer mimics the natural dentin and provides structural strength.
- **Enamel Layer:** A more translucent layer is placed over the dentin to replicate the enamel's reflective and light-scattering properties.
- **Incisal Layer:** In select cases, an additional translucent material is applied to the incisal edge to enhance depth, reflection, and natural esthetics.



> Moreover, the smooth and polished surface of nanofiller composites is much more resistant to plaque accumulation and staining from foods, drinks, and tobacco, which helps **prevent discoloration over time**.

> With precise control over morphology, size distribution, and dispersion, Mathym's restorative materials enhance **shade stability, blending capability, and light transmission**. This ensures restorations that are both highly functional and aesthetically superior, featuring a **luminous opalescence**, bright enamel, and a radiant, natural finish.

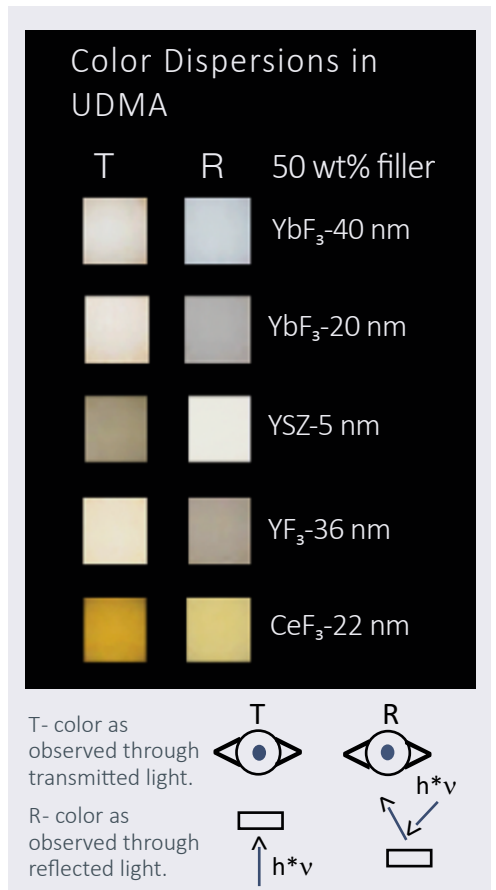
> Opalescence of nanofillers calculated from measured a and b values.

Mathym's Nanofillers	Opalescence
YbF-20	10.6
YbF-40	30.9
YSZ-5	1.6

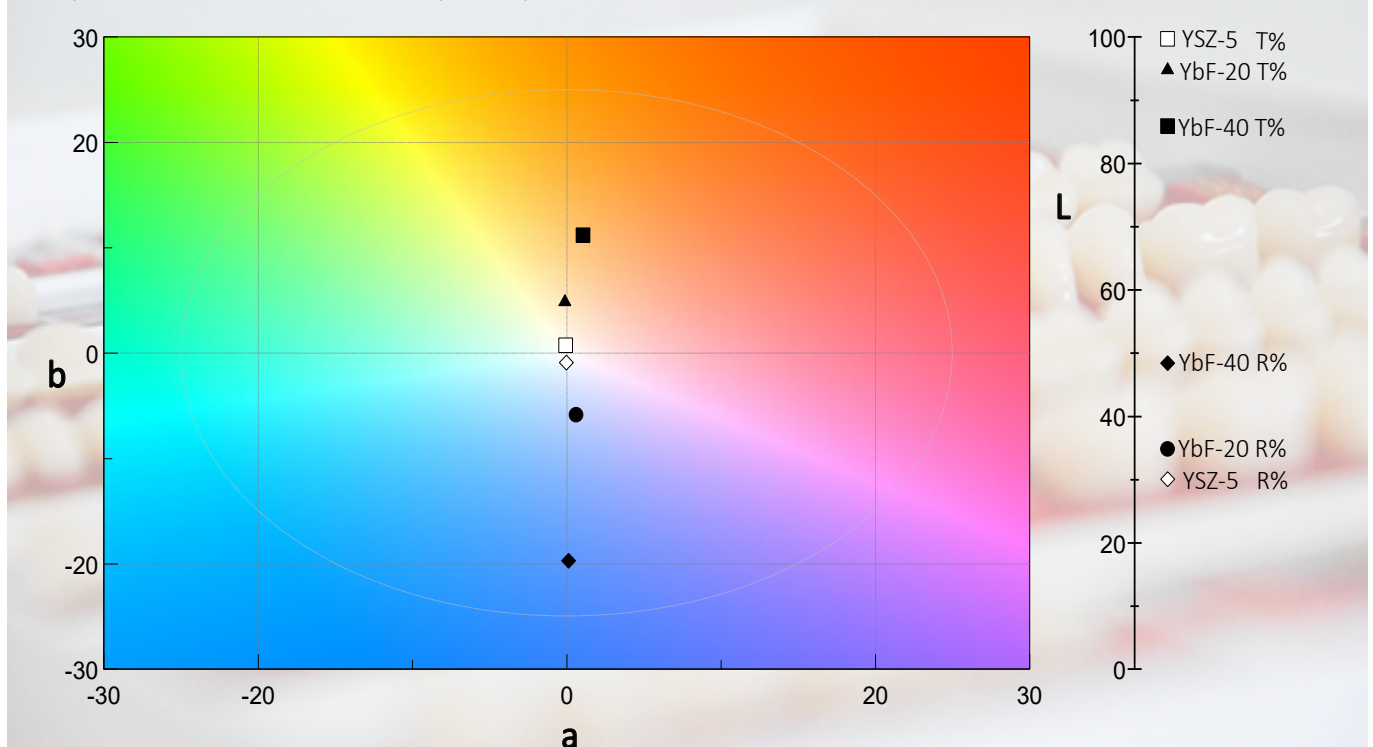
> Lab color space showing color points of nanofillers in aqueous dispersion.

Lab values are calculated from transmittance measurement (T%) or reflectance measurement (R%) using standard observer 2°, light source D65-2 and calculation range of 380-780 nm.

> Photography of **UDMA** monomer filled with 50 wt% of Mathym's nanofiller.



Color measurement – L a b
Dispersions in water, 1 mm optical path



Radiopacity For Clinician Precision In Restoration Monitoring

> Radiopacity enables clinicians to clearly distinguish restorations from surrounding tissues and accurately detect defects such as cement overhangs, microleakage, or interfacial gaps.

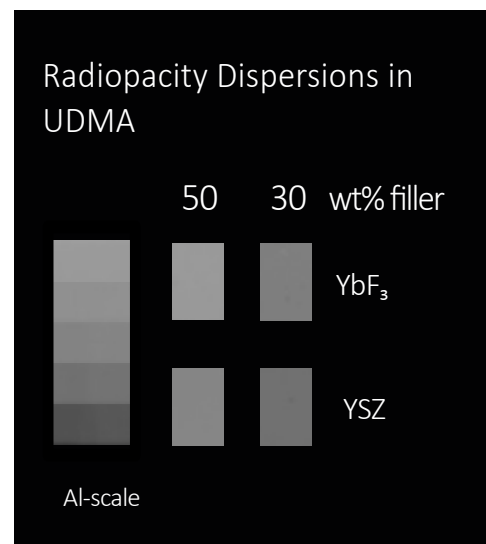
By incorporating highly radiopaque nanoparticles like filyxio® ytterbium fluoride (YbF₃), restorations exhibit **exceptional X-ray visibility**. This enhanced radiopacity facilitates **accurate diagnosis**, minimizing the risk of misinterpreting secondary caries and consequently avoiding unnecessary interventions.

Additionally, filyxio® nanodispersions, provide superior dispersion, translucency, and flexural strength while preserving esthetics.

> Refractive index (RI) of pure inorganic material and dental monomer UDMA charged with 50 wt% of nanofiller (refractive index of pure UDMA = 1.483)

Mathym's Nanofillers	RI materials	RI 50 wt% / UDMA
YbF-20	1.52	1.4924
YbF-40	1.52	1.4924
YSZ-5	2.1	1.4953

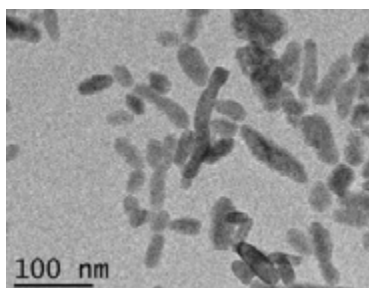
> X-ray photograph of dental monomer containing Mathym's nanofillers in comparison to Al-scale (1 step = 1.52 mm, inverted radiogram)



4. Mathym's Dental Next Product Innovations Include Prevention & Remineralization

> The field of dental restoration is evolving with **bioactive materials** enhancing both durability and prevention. Among them, Mathym® is currently developing advanced nano-yttrium, nano-cerium and nano-calcium fluoride solutions.

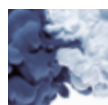
Nano Yttrium Fluoride



> YF₃ is a filler used to enhance the **radiopacity** of dental materials, making them visible on X-ray images.

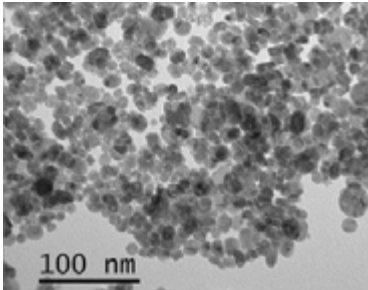
With a **refractive index of 1.51**, which closely matches that of most resins, YF₃ helps achieve optimal depth of cure.

The particle size is carefully engineered to match the **opalescence** of natural tooth structure, with a value of 22.5 (compared to 22.9 for dental enamel), contributing to a more natural appearance.





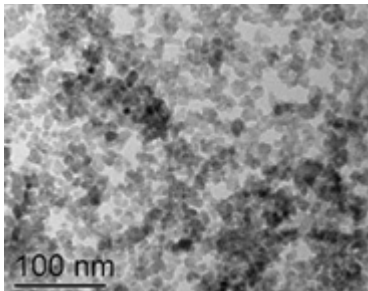
Nano Cerium Fluoride



> CeF_3 is known for its **high radiopacity**, making it useful as a radiopacifying agent in dental materials. Additionally, CeF_3 has fluoride-releasing properties, which can contribute to tooth remineralization and caries prevention.

As to Mathym's CeF_3 **high-crystallinity and narrow-size-distribution**, it offers advantages such as a high refractive index, bring yellow shade, improved mechanical properties, including enhanced flexural strength and hardness.

Nano Calcium Fluoride



> CaF_2 also plays a crucial **preventive and remineralizing role** in dentistry by releasing fluoride ions to strengthen enamel, inhibit bacterial activity, and reduce acid production.

When incorporated into composites, it enhances durability, resists secondary caries, and supports long-term oral health.

> The integration of nanofillers in dental materials has been addressing key challenges in durability, esthetics, and long-term prevention of dental composites.

These advancements complement different type of composites, such as the most used methacrylate-based composites, by improving their radiopacity, translucency, and mechanical strength, as well as ensure superior polymerization efficiency, shrinkage control, and durability.

As research continues, the synergy between nanofillers and resin-based composites will drive the next generation of high-performance bioactive and smart materials.

PRODUCT DESIGN

> [Contact us](#) and we will develop together the product that meets your dental specific needs and requirements.

Expanding Dental Solutions Within Baikowski® Group: Zirconia-based Ceramics

Within the Baikowski® Group, dental solutions extend beyond nanofillers to include ceramics materials such as **BSZ and ZTA/ATZ**.



Already established as a high-performance material for dental crowns, zirconia also holds great potential for use in dental implant fixtures. Its exceptional mechanical strength, biocompatibility, and stability make it a promising candidate for long-lasting and resilient dental restorations.





Your solution partner for fine minerals



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