YEEJIA
Oral ecological operator

Product Technical Support Manual

Chongqing Sailing3D Technology Co., Ltd.

Product Name: YEEJIA · Micro-nano-scale Grain Refinement Strengthening Process For SLM (MGRP-SLM)
Product Category: Customized Fixed Prosthesis
Model & Specification: YEEJIA · Micro-nano-scale Grain Refinement Strengthening Process For SLM (MGRP-SLM) (Standard Edition), YEEJIA · Micro-nano-scale Grain Refinement Strengthening Process For SLM (MGRP-SLM) (International Edition)
Main Raw Materials: Cobalt-chromium-molybdenum-tungsten (medical Stellite series) dental-specific selective laser melting alloy, general-purpose feldspathic porcelain powder

1 Metal Technical Specifications

1.1 Material Composition

The coping of this product is made of cobalt-chromium-molybdenum-tungsten (medical Stellite series) dental-specific selective laser melting alloy. The elemental composition is as follows:

Element	Content (%)
Cobalt (Co)	61.5±2
Chromium (Cr)	26.5±2
Molybdenum (Mo)	4.8±1
Tungsten (W)	5.5±1
Silicon (Si)	1.1±1
Niobium (Nb)	≤1.0
Nickel (Ni)	≤0.1

Note: The nickel content in the alloy powder does not exceed 0.1%, and the contents of beryllium (Be), cadmium (Cd), and lead (Pb) each do not exceed 0.02%.

1.2 Physical and Chemical Properties

The main physical and chemical properties of the metal body of this product are as follows:

Item	Specification
Vickers hardness	350–500 HV10
0.2% proof stress (non-proportional extension) Rp0.2	≥ 500 MPa
Bending properties (0.2% proof stress, non-proportional bending)	≥ 800 MPa
Elongation after fracture	≥ 10.0%
Young's modulus	210 ± 20 GPa
Density	8.6 ± 0.4 g/cm³
Coefficient of linear thermal expansion (room temperature–500°C)	14.0 ± 0.5 ×10⁻⁶ /K
Crack initiation strength	> 25 MPa
Corrosion resistance (total metal ion release at 37±1°C for 7 days)	≤ 200 μg/cm²
Solidus / liquidus temperature	1350 ± 50 ℃ / 1410 ± 50 ℃

Note: The test methods refer to the requirements for dental metal materials specified in YY/T 1702-2020, ISO 22674-2016, and GB 17168-2013.

1.3 Process Characteristics

It is manufactured by selective laser melting (SLM) additive manufacturing, combined with the micro-nano cladding process.

The micro-nano cladding process is a high-precision laser surface strengthening method developed on the basis of traditional laser cladding technology. Its basic principle is that, under the action of a high-energy laser, micron- or nano-scale powder is melted simultaneously with the substrate surface, and a dense strengthening layer metallurgically bonded to the substrate is formed through rapid solidification. Compared with traditional laser cladding, micro-nano cladding uses powder materials with finer particle size, a smaller laser spot, and lower heat input, which can significantly reduce the width of the heat-affected zone, improve microstructural uniformity and interfacial bonding quality, and effectively inhibit the formation of defects such as cracks and pores. The high cooling rate produced by rapid solidification can further refine the grains and improve the hardness, wear resistance, and corrosion resistance of the strengthening layer. Therefore, in recent years it has been widely used in fields such as aerospace, biomedicine, and high-end equipment manufacturing.

2 Porcelain Powder Technical Specifications

This product uses general-purpose feldspathic metal-ceramic porcelain powder (feldspathic PFM porcelain), matched with the cobalt-chromium coping system, and adopts a five-layer composite sintering structure. The function of each layer is as follows:

Layer Order	Porcelain Layer Type	Function
Layer 1	Opaque porcelain	Covers the metal base color and establishes the base shade of the restoration
Layer 2	Opaque porcelain	Secondary opaquing to further improve light-blocking and shade stability
Layer 3	Dentin porcelain	Main body of the restoration, presenting the body color and gradation of the tooth
Layer 4	Translucent / enamel porcelain	Simulates enamel translucency and the incisal translucent effect
Layer 5	Glaze	Surface densification, controlling gloss and surface smoothness

Note: The porcelain powder of this product is a general-purpose feldspathic system. The specific supplied porcelain powder model can be matched according to clinical needs and laboratory practice, and is not tied to a single commercial brand.

The key physical and chemical properties of the feldspathic metal-ceramic porcelain powder are as follows. The core requirement is that the coefficient of thermal expansion must match that of the cobalt-chromium coping — the thermal expansion coefficient of the porcelain should be slightly lower than that of the metal, so that the metal-ceramic crown does not fracture from tensile stress in the porcelain layer during cooling.

Item	Reference Range
Coefficient of thermal expansion (25–500°C)	Approx. 9–14 $\times 10^{-6}$ /°C, matched with the coping metal ($14.0 \pm 0.5 \times 10^{-6}$ /K)
Sintering temperature range	Approx. 750–950°C
Particle size	D50 approx. 20–40 μm

Flexural strength	≥ 80 MPa (metal-ceramic veneering porcelain)
Sintered density	≥ 2.4 g/cm³, porosity ≤ 5%
Color stability	ΔE ≤ 1.0
Water absorption	≤ 0.3%

Note: The metal-porcelain system compatibility assessment refers to ISO 9693; the porcelain powder properties refer to ISO 6872 and the GB/T requirements for dental ceramic materials. The values in the table are general reference ranges for feldspathic metal-ceramic systems; the actual supplied porcelain powder inspection report shall prevail.

3 Porcelain Application Process Technical Specifications

3.1 Process Flow

The porcelain application process for metal-ceramic crowns (PFM) can be divided into three stages: ① metal coping surface treatment → ② porcelain layering → ③ sintering and glazing, detailed as follows:

① Metal Coping Surface Treatment (Pre-treatment)

The cleanliness, roughness, and pre-oxidation state of the metal coping surface directly determine the metal-porcelain bond strength and are the basis for preventing porcelain fracture.

Procedure	Operation	Purpose
Cleaning	Rinse the metal coping with running water and dry it	Remove machining residues from the surface
Grinding and roughening	Grind the surface in one direction with fine-grit aluminum oxide stone, then sandblast with 80–200 mesh aluminum oxide at a pressure of 2–2.5 bar (2–4×10⁵ Pa) for 10–20 s, with the nozzle at 45° to the surface	Remove surface contaminants and oxide film, form a micro-roughened surface, and increase the mechanical interlocking between metal and porcelain
Ultrasonic cleaning	After sandblasting, place in distilled water (deionized water) and clean ultrasonically for 5–10 min, then dry with clean compressed air	Remove dust and oil residues inside the roughened surface to keep the surface clean
Degassing	Place the coping in a vacuum porcelain furnace, heat to near the sintering temperature of the porcelain powder as required by the material, and hold for several minutes	Expel the gas adsorbed by the metal substrate during manufacturing to prevent bubble formation during sintering
Pre-oxidation	Heat in air for pre-oxidation (temperature and time determined by the metal and porcelain powder system used), then remove and cool	Form a uniform, stable oxide film on the surface to improve the metal-porcelain bond strength

Note: For certain porcelain powder systems (e.g., some pre-oxidation-free porcelain powders), the pre-oxidation step can be omitted. Formal production shall follow the operating instructions of the porcelain powder supplier.

② Porcelain Layering

The porcelain layers are built up layer by layer in the order of opaque porcelain → cervical porcelain → dentin (body) porcelain → incisal/translucent porcelain, and sintered layer by layer.

Order	Porcelain Layer	Function	Reference Thickness
1	Opaque porcelain – Layer 1	Covers the metal base color and establishes the basic shade of the restoration	Apply thinly per layer; the two layers total approx. 0.1–0.2 mm
2	Opaque porcelain –	Secondary opaquing to uniformly	Same as above

	Layer 2	cover shade lines	
3	Dentin (cervical) porcelain	Builds the main tooth body and cervical shade	1.0～1.5 mm
4	Dentin (body) porcelain	Presents the body color and gradation	Same as above
5	Incisal / translucent porcelain	Simulates the incisal and enamel translucency	Approx. 0.5 mm

Note: According to the porcelain powder type, this product has a five-layer structure of '2 opaque + 1 dentin + 1 translucent + 1 glaze'; the 'cervical, body, and incisal porcelain' in the table are subdivisions of the dentin/enamel porcelain categories by tooth position, and the two are not contradictory.

Layering Operation Key Points:

Opaque porcelain: Take an appropriate amount of porcelain powder on a glass slab, mix it with the special liquid into a slurry, apply a thin layer to the surface with a nylon brush, and absorb the excess water. After two coats, a uniform opaque layer that completely blocks the metal base color is formed.

Dentin porcelain: Build up the main body according to the morphology of the tooth to be restored, absorbing excess water and reserving space for the incisal and translucent porcelain; where necessary, leave a compensation for porcelain shrinkage — the green porcelain body should be about 10%–20% larger than the actual full crown to compensate for sintering shrinkage.

Translucent/enamel porcelain: Add translucent porcelain at the incisal edge and margins to create the light-transmission gradation.

Layer-by-layer sintering: After each layer is built up, pre-dry at the furnace door for 3–5 minutes before loading into the furnace, then push into the furnace for sintering; after completion, cool slowly and naturally before building the next layer.

③ Sintering and Glazing

Sintering and curing: Sinter layer by layer under vacuum according to the sintering temperature curve in Table 3-2 to cure the porcelain layer; after each sintering, cool slowly and naturally, and rapid cooling is strictly prohibited to prevent cracking of the porcelain layer.

Morphological adjustment: After sintering, adjust the occlusion and contour of the restoration; use a low-speed stone for grinding to minimize vibration.

Glazing: This can be performed after intraoral try-in and occlusal adjustment. Thin the glaze powder into a slurry, brush it on thinly, and place in the furnace for sintering (or glaze naturally and sinter once more) to make the surface fused and glossy; after glazing, do not grind the porcelain layer again.

Cooling and inspection: After slow cooling is complete, clean and inspect the porcelain layer for bubbles, cracks, and delamination; deliver for clinical try-in after passing inspection.

3.2 Sintering Temperature Parameters (Reference Curve)

The sintering temperature curve for this process is shown in the table below. The actual values are subject to the technical data of the porcelain powder used, and the temperature must be strictly controlled during operation.

Porcelain Stage	Pre-drying	Heating rate	Sintering temperature	Holding time	Remarks
First dentin porcelain layer (including opaquing)	400℃ / 6min	50℃/min	975℃	1 min	Sintered under vacuum
Second dentin porcelain layer	400℃ / 6min	50℃/min	960℃	1 min	Sintered under vacuum
Translucent porcelain+glazing	400℃ / 4min	80℃/min	945℃	1 min	Surface densification

(Glaze)					

Note: The sintering curve varies slightly between different batches of porcelain powder. Formal production shall follow the sintering schedule provided by the porcelain powder supplier; this table is for reference only.

3.3 Operation Key Points

Pre-dry fully before sintering to prevent porosity and cracking of the porcelain layer caused by moisture.

Strictly control the sintering temperature and holding time to avoid shade deviation caused by over-firing.

Set the glazing temperature and rate separately to ensure a glossy surface without damaging the underlying structure.

4 Biocompatibility

The main raw materials used in this product — cobalt-chromium-molybdenum-tungsten (medical Stellite series) dental-specific selective laser melting alloy and general-purpose feldspathic porcelain powder — have all obtained national medical device registration certificates, are conventional dental material systems validated by long-term clinical use, and have completed biocompatibility testing with all tests passing. The test items include:

Test Item	Applicable Standard
Acute systemic toxicity	GB/T 16886.11
Intradermal reaction	GB/T 16886.10
Skin sensitization / delayed-type hypersensitivity	GB/T 16886.10
Genotoxicity – Ames test	GB/T 16886.3
In vitro mammalian cell TK gene mutation test	GB/T 16886.3
Chromosome aberration test	GB/T 16886.3
Cytotoxicity test	GB/T 16886.5
Subchronic systemic toxicity	GB/T 16886.11

5 Effect on Magnetic Resonance Imaging (MRI)

5.1 Background and Rigorous Statement

Metal-ceramic crowns contain a metal coping. Cobalt-chromium alloy is a non-ferromagnetic (or weakly magnetic) material that causes less magnetic field interference than alloys such as nickel-chromium, but it is still recommended to inform the imaging physician before the examination.

5.2 Artifact Test Report

This product has been tested by a professional institution (test report numbers: GC202601142016, GC202601142018). Its magnetic parameters and safety indicators in the MRI environment all comply with the safety requirements for clinical MRI examination, and it can be safely used in patients who require MRI examination.

Testing shows that, in clinically common 1.5T / 3.0T MRI magnetic fields, the magnetization and residual magnetism of this product are far below the safety values, and the magnetic force is far smaller than the retention force of oral tissues, with no risk of displacement; the imaging artifact range is controllable and does not interfere with the imaging quality of surrounding alveolar bone, nerves, and other tissues; and it will not cause burns to the oral mucosa.

Note: Before undergoing head/oral-maxillofacial MRI examination, the patient should still proactively inform the imaging physician of the presence of the metal restoration, and the physician will evaluate the examination plan.

6 Indications

This product is a metal-ceramic crown for fixed restoration, suitable for the following clinical situations:

1) Teeth that require restoration after root canal treatment due to pulp disease, periapical lesions, cracks, or other reasons

2) Discolored teeth, such as non-vital teeth, tetracycline-stained teeth, and fluorosis teeth, that are not suitable for restoration by other methods

3) Malformed small teeth, enamel hypoplasia, and other teeth requiring improvement of crown morphology

4) Patients with malpositioned or rotated anterior teeth that are unsuitable or unable to undergo orthodontic treatment but require improvement of anterior tooth aesthetics

5) Restoration of single-tooth defects and as retainers for fixed partial dentures

6) Implant-supported restorations and implant ceramic crowns

7) Fixed splints for periodontal splinting therapy

7 Contraindications

Fixed metal-ceramic crowns are not suitable or should be used with caution in the following situations:

1) Adolescents whose permanent teeth are not fully developed (with wide pulp chambers), at high risk of pulp injury

2) Teeth that are too small to obtain adequate retention/resistance form, with insufficient retention and easy dislodgement of the restoration

3) Insufficient space for tooth preparation

4) Patients with severe periodontal disease, uncontrolled root lesions, loose teeth, or non-vital teeth without complete root canal treatment

8 Clinical Tooth Preparation and Crown Delivery Procedure Reference

The following is the routine clinical procedure and operational requirements for metal-ceramic crowns, provided only for reference by clinicians and technicians; the final operation is subject to the judgment of the licensed dentist.

8.1 Tooth Preparation

Step	Operation Requirements (Reference Values)
Incisal / occlusal preparation	Use a cylindrical coarse diamond bur to create 2–3 depth-grooves about 1.5–2.0 mm deep, then reduce evenly to the groove depth to complete the incisal/occlusal cut
Labial (buccal) preparation	Create vertical depth-grooves of 1.0–1.5 mm deep in the incisal half and cervical half of the labial surface respectively, then reduce evenly; in the metal-ceramic coverage area, reduce the labial surface by approx. 1.2–1.5 mm
Proximal preparation	Keep the bur parallel to the long axis of the tooth and control the proximal convergence angle at 2°–5° (near-parallel, not too large, to prevent loss of retention)
Lingual (palatal) preparation	For metal-ceramic coverage, reduce approx. 1.0–1.5 mm of space to ensure adequate clearance in both centric and protrusive occlusion
Cervical margin / shoulder preparation	First place retraction cord; position the shoulder 0.5–0.8 mm subgingivally, 1.0–1.5 mm wide on the labial side and 0.8–1.2 mm on the proximal/lingual side, forming a continuous, smooth 135° rounded shoulder
Polishing and finishing	Polish all surfaces with a fine-grit diamond bur to eliminate sharp point and line angles and shoulder overhangs

8.2 Impression / Shade Selection / Temporary Crown

1) Before taking the impression, place retraction cord in the gingival sulcus, select an appropriate tray, and take a complete impression of the abutment, opposing, and adjacent teeth with silicone rubber/polyether material; after checking that the impression has no bubbles or deformation, pour a die stone model.

2) The dentist and patient select the shade together so that the color of the restoration is close to the adjacent teeth.

3) Fabricate a resin temporary crown and seat it with temporary cement to protect the prepared tooth, maintain proximal contact and occlusion, and prevent food impaction.

8.3 Try-in

1) Remove the temporary crown and try the ceramic crown in the mouth, checking in sequence:

Seating: if seating is difficult, check for protrusions on the inner surface of the coping, proximal contacts, and sharp shoulder edges;

Marginal fit: the crown margin should fit tightly against the tooth (abutment) with no gap detectable by the explorer;

Proximal contact: test the tightness of proximal contacts with dental floss; grind slightly if too tight, add porcelain if too loose;

Morphology and color: make appropriate adjustments based on the shape of adjacent teeth and the patient's opinion;

Occlusion: check centric, protrusive, and lateral occlusion respectively, mark premature contacts with articulating paper and adjust, eliminating occlusal high points.

2) After the try-in is confirmed acceptable and before final cementation, sandblast the inner surface of the metal coping to roughen it for better bonding of the cement.

8.4 Cementation (Luting)

1) For vital teeth, choose a cement with low pulp irritation (such as glass ionomer or zinc polycarboxylate cement), and perform pulp protection and apply dentin bonding primer before cementation; for non-vital teeth, a fluoride-containing resin cement can be used to help prevent secondary caries and promote remineralization.

2) Before cementation, ultrasonically clean the restoration and dry it, disinfect and dry the abutment surface; mix the cement according to the product instructions and apply it evenly to the inner surface of the crown and the abutment surface, seat under pressure until the cement is fully cured, then remove the excess cement and polish the margins.

3) Avoid chewing on the treated side within 24 hours after cementation, until the cement reaches its final strength.

8.5 Delivery of Implant-Supported Ceramic Crown (Supplementary)

The implant-supported ceramic crown can be seated by cement retention or screw retention (fixed to the implant by a central screw); for screw-retained crowns, tighten the central screw to the appropriate torque after seating and (depending on the design) seal the access hole with glass ionomer or similar.

After delivery, check the fit between the crown and abutment, margins, proximal contacts, and occlusion to avoid excessive occlusal force that could traumatize the implant.

8.6 Recall and Maintenance

During follow-up, regularly review the marginal fit, proximal contacts, occlusion, and periodontal health of the restoration; if necessary, take X-rays to observe the condition around the abutment/implant.

If marginal misfit, secondary caries, porcelain fracture, loosening, or dislodgement occurs, return for treatment promptly.

9 Precautions for Use

1. Clinical examination: Fully assess the tooth, periodontal, and occlusal conditions before restoration, and rule out contraindications.

2. Allergy confirmation: Patients with metal allergies should undergo a patch test first.

3. MRI reminder: When an MRI examination is required, proactively inform the imaging physician of the presence of this metal restoration.

4. Post-placement observation: There may be slight foreign-body sensation or thermal sensitivity initially, which generally resolves in the short term; if discomfort persists, return for follow-up.

5. Occlusal management: Avoid chewing excessively hard foods; patients with bruxism are advised to use an occlusal splint to reduce the risk of porcelain fracture.

6. Oral hygiene: Maintain good brushing and flossing to prevent gingivitis and secondary caries.

7. Regular recall: Review the fit, proximal contacts, and periodontal health of the restoration every 6–12 months.

10 Frequently Asked Questions (FAQ)

This section answers common questions from clinicians and patients. Specific diagnosis and treatment decisions are subject to the clinical judgment of the licensed dentist.

10.1 How long can the YEEJIA Micro-nano-scale Grain Refinement Strengthening Process For SLM (MGRP-SLM) crown last?

In theory, this product can be used for a long time. However, due to individual differences in the patient's oral environment, occlusal habits, and daily maintenance, the actual service life is subject to the clinical judgment of the attending dentist. When the patient has periodontal disease, root canal treatment, poor occlusal habits, or other conditions, the service life may be significantly shortened. Regular recall is recommended so that the dentist can assess the condition of the restoration.

10.2 Is it likely to cause allergy?

The metal coping of this product is made of cobalt-chromium-molybdenum-tungsten (medical Stellite series) dental-specific selective laser melting alloy. Combined with the micro-nano cladding process, its ion release is <0.1 μg/mm², far lower than that of gold (gold is 0.4 μg/mm², ordinary metal is 4.8 μg/mm²), and its anti-allergy performance is superior to gold. For individual patients with hypersensitivity, an allergy test is recommended first, subject to the patient's own condition and the physician's advice.

10.3 Can it undergo magnetic resonance imaging (MRI)?

This product has been tested by a professional institution (report numbers GC202601142016 / GC202601142018). Its magnetic parameters and safety indicators in the MRI environment all comply with the safety requirements for clinical MRI examination, and it can be safely used in patients who require MRI examination.

10.4 Will the porcelain chip?

The porcelain layer of a ceramic crown has strong compressive strength but low toughness and high brittleness; the risk of chipping is mainly related to occlusal force, porcelain thickness, and occlusal design. This product improves the metal-porcelain bond strength and chipping resistance through the feldspathic five-layer porcelain structure (double opaque porcelain + dentin porcelain + translucent porcelain + glaze) and metal surface pre-oxidation treatment. In daily life, avoid chewing excessively hard foods (such as crab shells, bones, sugarcane, bottle caps, etc.); patients with bruxism are advised to wear an occlusal splint to reduce the risk of chipping.

10.5 How should I care for it daily? Can I have dental scaling?

Clean gently with a soft-bristle toothbrush and fluoride toothpaste, focusing on the crown margins, and avoid long-term forceful horizontal brushing. Use dental floss or an oral irrigator to clean the proximal surfaces and gingival sulcus.

Regular dental scaling is allowed, but inform the dentist that there is a restoration in the mouth, and the dentist should avoid prolonged direct contact of the ultrasonic scaler tip on the crown margins.

Rinse promptly after dark-colored drinks (coffee, strong tea, red wine) to reduce staining of the cement margins.

An oral examination and maintenance every 6–12 months is recommended.

10.6 What if it becomes loose, falls off, or the gums become red, swollen, or bleeding?

If the crown becomes loose, falls off, or the gums become red, swollen, or bleeding, seek dental care as soon as possible. Do not handle a loose crown by yourself; keep a dislodged crown properly, and do not wear it again by yourself to avoid swallowing or injury. Return for treatment promptly so that the dentist can re-cement it.

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Technical Support Organization: Chongqing Sailing3D Technology Co., Ltd. (Provision of technical support and semi-finished products)

Website: www.sailing3d.cn

Tel: 023-63177016

Address: Room 4-3, No. 1563 Songqing Road, Dadukou District, Chongqing, China