

DENTAL METALS AND ALLOYS

Dental metals and alloys are extensively used in dentistry for the restoration and replacement of missing or damaged teeth. They are preferred because of their high strength, durability, corrosion resistance, and biocompatibility. Since the oral cavity is a hostile environment with saliva, fluctuating pH, and mechanical stresses, dental materials must maintain their properties for long periods.

Requirements of an Ideal Dental Metal or Alloy

An ideal dental metal or alloy should possess the following properties:

- High mechanical strength and toughness
- Excellent corrosion and tarnish resistance
- Biocompatibility with oral tissues
- Adequate hardness and wear resistance
- Good castability and ease of fabrication
- Dimensional stability
- Acceptable aesthetic appearance

Classification of Dental Metals and Alloys

Dental metals and alloys are broadly classified into:

1. Noble Metal Alloys

Noble metal alloys contain metals that are highly resistant to corrosion.

Examples: Gold (Au), Platinum (Pt), Palladium (Pd)

Properties: Excellent corrosion resistance, High ductility and Malleability, Superior biocompatibility

Applications: Dental crowns, Bridges, Inlays and onlays

2. Base Metal Alloys

Base metal alloys are strong and economical compared to noble alloys.

Examples: Nickel–Chromium (Ni–Cr), Cobalt–Chromium (Co–Cr), Stainless steel

Properties: High strength and hardness, Good wear resistance Lower cost

Applications: Partial denture frameworks, Orthodontic wires, Dental Prosthesis

3. Titanium and Titanium Alloys

Examples: Commercially pure titanium, Ti–6Al–4V alloy

Properties: Excellent biocompatibility, High corrosion resistance, Low density and high strength
Applications: Dental implants, Implant-supported prostheses

4. Dental Amalgams

Dental amalgam is an alloy formed by mixing mercury with other metals.

Composition: Mercury, Silver, Tin, Copper

Properties: High compressive strength, Good durability, Easy manipulation

Applications: Posterior tooth restorations

Properties of Dental Metals and Alloys:

- Mechanical strength: Withstand mastication forces
- Corrosion resistance: Resist degradation in saliva
- Biocompatibility: Safe and non-toxic
- Thermal conductivity: Important for patient comfort
- Wear resistance: Ensures long service life

Applications of Dental Metals and Alloys:

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- Crowns and bridges
- Dental implants
- Orthodontic appliances
- Restorative fillings
- Denture frameworks

Advantages

- High durability and long service life
- Excellent mechanical strength
- Good corrosion resistance
- Suitable for load-bearing dental restorations

Limitations

- Poor aesthetics compared to ceramics.
- Possible allergic reactions (especially Ni-based alloys).
- High thermal conductivity may cause sensitivity.
- Mercury toxicity concerns in amalgams.

8. DENTAL CERAMICS

Dental ceramics are inorganic, non-metallic materials that are widely used in dentistry for the fabrication of restorations such as crowns, bridges, veneers, inlays, onlays, and dentures. These materials are mainly composed of compounds of oxygen

with metals or metalloids such as silica, alumina, and zirconia. Dental ceramics are popular because of their excellent esthetics, biocompatibility, and resistance to chemical degradation in the oral environment.

Composition of Dental Ceramics

Dental ceramics are mainly composed of the following components:

1. **Feldspar** – Acts as a glass former and provides translucency and esthetics.
2. **Quartz (Silica)** – Provides strength and structural stability.
3. **Kaolin (Clay)** – Acts as a binder and improves the handling properties during shaping.

Modern dental ceramics may also contain:

- Alumina (Al_2O_3) for increased strength
- Zirconia (ZrO_2) for high fracture resistance
- Glass modifiers such as potassium oxide and sodium oxide.

Classification of Dental Ceramics

1. **Based on Firing Temperature**
 - High fusing ceramics (above 1300°C)
 - Medium fusing ceramics ($1100\text{--}1300^\circ\text{C}$)
 - Low fusing ceramics ($850\text{--}1100^\circ\text{C}$)
 - Ultra-low fusing ceramics (below 850°C)
2. **Based on Application**
 - All-ceramic restorations
 - Metal-ceramic restorations (Porcelain fused to metal – PFM)
3. **Based on Composition**
 - Feldspathic porcelain
 - Alumina-based ceramics

- Zirconia-based ceramics
- Glass ceramics

Properties of Dental Ceramics

1. **High compressive strength**
2. **Excellent esthetics and translucency**
3. **Biocompatibility** with oral tissues
4. **High resistance to wear and corrosion**
5. **Low thermal and electrical conductivity**
6. **Brittle nature with low tensile strength**

Advantages of Dental Ceramics

- Excellent natural tooth-like appearance
- High color stability
- Resistant to staining
- Biocompatible and non-toxic
- Good wear resistance

Disadvantages of Dental Ceramics

- Brittle and prone to fracture under tensile stress
- Requires complex laboratory procedures
- Difficult to repair once fractured
- Higher cost compared to other restorative materials

Applications of Dental Ceramics

Dental ceramics are widely used in modern dentistry for:

- Crowns and bridges

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- Veneers
- Inlays and onlays
- Denture teeth
- Implant restorations
- Orthodontic brackets

Dental ceramics play an important role in restorative and prosthetic dentistry due to their excellent esthetic qualities, chemical stability, and compatibility with oral tissues. With advancements in ceramic technology such as zirconia and glass ceramics, dental ceramics have become stronger and more durable, making them one of the most preferred materials for aesthetic dental restorations.