Dental ceramics and porcelain

Ashur University college

Dr. Mohammed Moudhaffer

The term *ceramic* refers to any product made from a nonmetallic inorganic material usually processed by firing at a high temperature to achieve desirable properties.

***porcelain* refers to a specific compositional range of ceramic materials originally made by mixing kaolin (hydrated aluminosilicate), quartz (silica), and feldspars (potassium and sodium aluminosilicates), and firing at high temperature.**

Dental ceramics for metal-ceramic restorations belong to this compositional range and are commonly referred to as dental porcelains.

Properties of dental ceramics:

- **Corrosion-resistant.**
- **Non-reactive with liquids, gases, alkaline, and acids.**
- **Stable for a long time.**
- **Excellent flexure strength and fracture toughness like zirconium dioxide.**
- **Strong, resilient, temperature resistant but brittle when flexed or quickly heated and cooled**
- **Potential matching of natural tooth appearance, translucency which help light transmission for luting resin polymerization.**
- **Excellent thermal and electrical insulation.**

Uses and applications:

- **Inlays and Onlays.**
- **Esthetic laminates (veneers) over natural teeth.**
- **Single (all-ceramic) crowns.**
- **Short span (all-ceramic) bridges.**
- **As veneer for cast metal crowns and bridges (metal ceramics).**
- **Artificial denture teeth (for complete denture and partial denture use).**
- **Ceramic orthodontic brackets.**
- **Dental implant fixture.**

Application of ceramic in dentistry













Disadvantages of dental ceramics

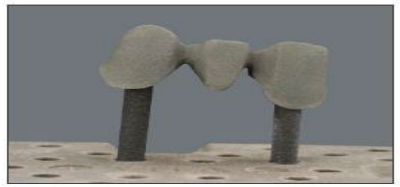
1. **Susceptible to brittle fracture.**
2. **Technique sensitive.**
3. **Thermal expansion mismatch with metals.**
4. **Abrasion resistant (abrade natural opposing teeth).**

Classification of dental ceramics according to fusion temperature:

1. **High approximately 1300 C, used for denture teeth.**
2. **Medium approximately 1100-1300 C, used for denture teeth.**
3. **Low approximately 850-1100 C, used for crown and bridges.**
4. **Ultralow less than 850 C, used for crown and bridges.**

Ceramics processing :

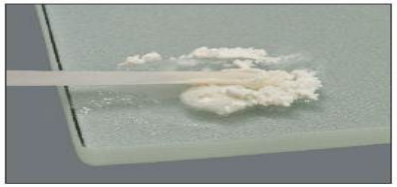
1. **Sintering is the process of firing the compacted ceramic powder at high temperature to ensure optimal densification.**



Metal substructure



Body Porcelain



Mixing porcelain Powder



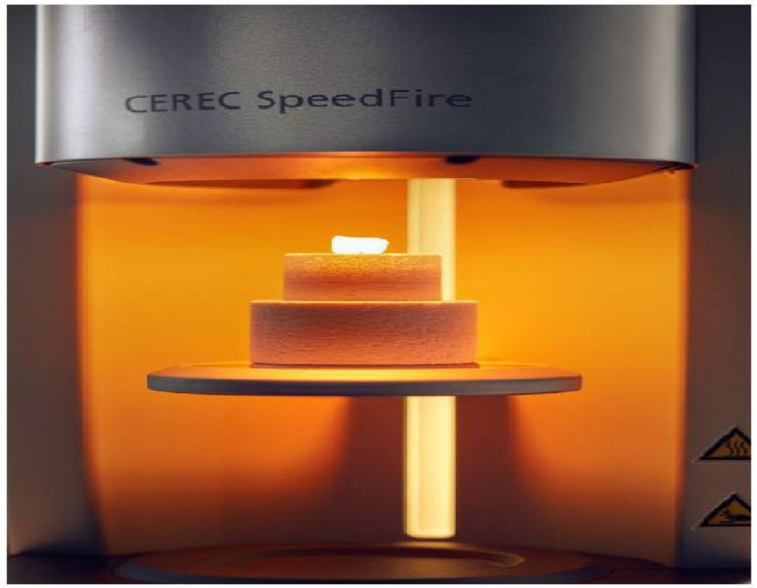
Applied Glaze



Opaque Porcelain



Final Restoration



Porcelain firing furnace

2. **Machined ceramics:**

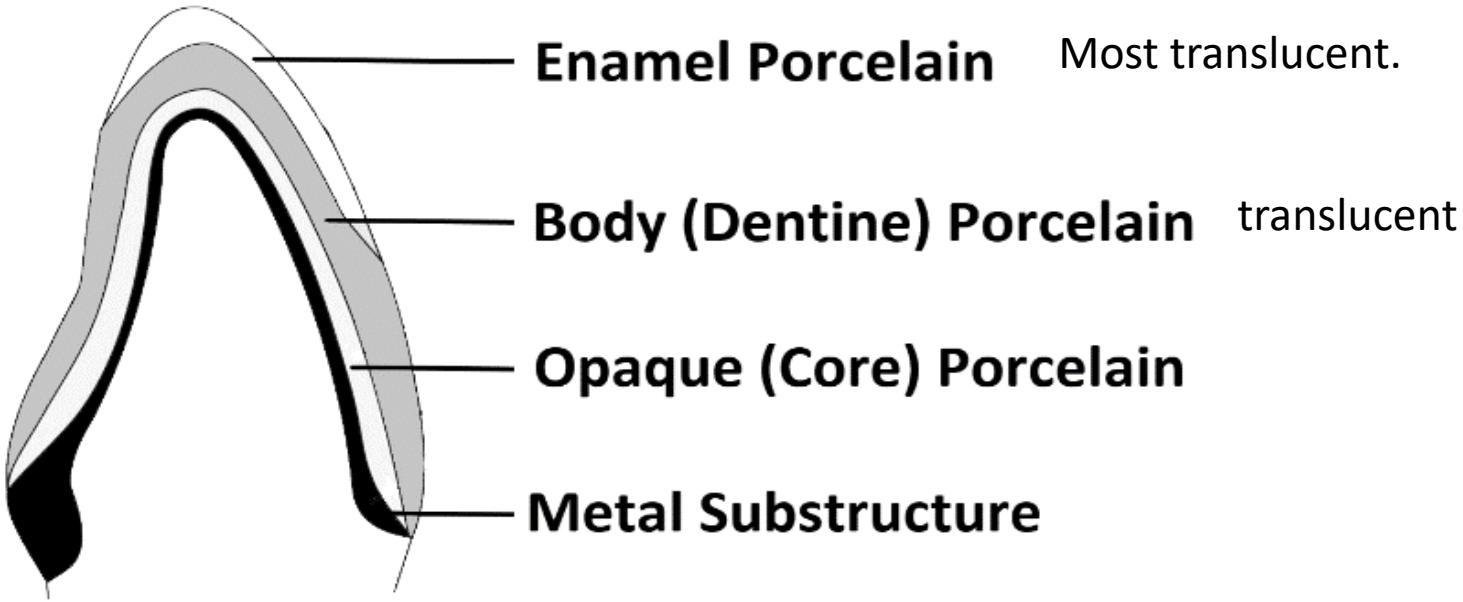
CAD/CAM (computer aided designing/ computer aided machining):

➢**An optical impression is scanned then transferred to computer. The restoration is designed by computer aid then it is milled from ceramic block by the milling machine.**





Dental porcelain According to translucency:



Factors affecting porcelain bonding to metals

1. **wetting: better wettability of the ceramic paste on the metal surface assure better bonding.**
2. **Oxides on metals: the type of bond between metal alloy and the dental ceramic is chemical based on the metal oxides on the surface of the alloy.**
3. **Surface texture: rough metal surface means more surface area of contact with the dental ceramic.**

Ceramic composition:

1.Feldspar:

- **They are anhydratedaluminum silicate.**
- **They are mixture of potassium aluminum silicate ($K_2O.Al_2O_3.6SiO_2$) and sodium aluminum silicate ($Na_2O.Al_2O_3.6SiO_2$).**
- **Upon heating at high temperature (1125 °C and 1170 °C) they become glassy.**

2. Silica (Quartz):

- **It is remains unchanged during the firing process as a fine crystalline dispersion. Therefore, it acts as a strengthening agent.**

3. Glass modifiers:

- They are metal ions as Na+, K+or Ca++.

Effect of glass modifiers:

a)Lowering softening temperature to produce low fusing porcelain (fluxes).

b)Increase thermal expansion.

c)Increase fluidity of the porcelain during firing.

4. Kaolin act as a binder, it is opaque even in very small quantity. It was used in earliest porcelain and not used in modern porcelains but replaced with sugar and starch.

5. Fluxes used to decrease sintering temperature therefore prevent metal framework deformation , like boron oxide based glass.

6. Pigments: they are metallic oxide powders mixed with fine glass and feldspar powder used to obtain various shades to simulate natural teeth, like iron & nickel (brown), copper (green), titanium (yellowish-brown)