Ceramic for dental

In Dental science, ceramics are referred to as nonmetallic, inorganic structures primarily containing compounds of oxygen with one or more metallic or semi-metallic elements. They are usually sodium, potassium, calcium, magnesium, aluminum, silicon, phosphorus, zirconium & titanium. Ceramics have excellent intraoral stability and wear resistance adding to their durability. Basically ceramics are used as indirect restorative materials such as crowns and bridges, Inlays and dental implants. Recently ceramic braces are used in orthodontics.

Dental cements are basically glasses. Initially, silicate cements were introduced. The cement powder contains a glass of silica, alumina and fluorides. The liquid, on the other hand, is an aqueous solution of phosphoric acid with buffer salts. The cement powder and liquid are mixed together resulting in an acid-base reaction. Fluoride ions are leached out from the set cement, which is responsible for the anti-cariogenic property exhibited. Cements are direct restorative materials – i.e. manipulated and placed onto teeth directly, unlike other restorations that are made outside and fixed to teeth, called indirect restorations. They are highly advantageous as they are quick to set, release fluoride leading to anti cariogenic action, esthetic and chemically bond to tooth material.

Classification of dental ceramics Based on Composition

Dental ceramics can classified according to their composition to:

Silicates ceramic are characterized by amorphous glass phase, containing predominantly silica.

Oxide ceramics: It is notable that only oxide ceramics are used in dentistry, since nonoxide ceramics are difficult to process. Oxide ceramics contain a principal crystalline phase like Alumina. Zirconia has very high fracture toughness.

Glass ceramics: These are type of ceramics that contains a glass matrix phase & at least one crystal phase such as Carbides nitrides.

Surface modification of dental implants

A dental implant is an artificial tooth root used in dentistry to support restorations that resemble a tooth or group of teeth: dental prostheses, including crowns, implant-supported bridges, or dentures. Dental implants are currently manufactured by Ti and its alloys due to their superior biocompatibility, enhanced corrosion resistance, and lower modulus of

elasticity when compared to conventional cobalt-based alloys and stainless steels.

The majority of dental implants are made of commercially pure titanium (CP-Ti), which is available in four grades, depending upon the amount of carbon, oxygen, nitrogen, and iron contained. Ti alloy with 6 wt% aluminum (Al) and 4 wt% vanadium (V), Ti–6Al–4V alloy, is believed to offer similar osseointegration levels as CP-Ti. Today, most implants are still made out of CP-Ti, but some implant systems are fabricated from the Ti–6Al–4V alloy.

Implant surfaces may be modified by plasma spraying of hydroxyapatite (HA), anodizing (micro-arc oxidation), etching, or blasting to increase the surface area and the integration potential of the implant. The most important reason for the surface modification of Ti is the improvement of hard-tissue compatibility through the formation of a HA film. Currently, plasma spraying of HA on metallic materials is widely used to form the HA layer—which is the nucleus for active bone formation and conductivity. In the case of plasma sprayed HA, however, the HA–Ti interface or HA itself may fracture under relatively low stress because of the low interface bonding strength and low toughness of the sprayed layer itself. The solubility of ceramics increases as their crystallinity decreases. The crystallinity of coated HA is an important factor because crystallinity governs solubility in the human body. The crystallinity of a thin film formed with ion beam is low, thus its solubility is high. A poorly crystalline film on Ti dissolves rapidly when the Ti is implanted into a human body. Thus, heat treatment of HA films is necessary to increase their crystallinity and reduce their solubility. Calcium ions are implanted during the mixing process to induce strong bonding between the HA film and the Ti substrate, with implanted calcium ions serving as binders.

Currently, HA is also used for fixture base. Some current research in dental implantology is focusing on the use of ceramic materials such as zirconia (ZrO_2). Zirconia is the dioxide of zirconium, a metal close to titanium in the periodic table. However, the surface properties of zirconium are different from those of Ti. Although generally having the same shape as Ti implants, zirconia, which has been used successfully for orthopaedic surgery for a number of years, has the advantage of being more cosmetically esthetic owing to its bright tooth-like colour.