Recent Advancement In Composites – A Review

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ABSTRACT - *Composite restorative materials represent one of the many successes of modern biomaterials research, since they replace biological tissue in both appearance and function. At least half of posterior direct restoration placements now rely on composite materials (Sadowsky, 2006). Unfortunately, demands on these restorations with regard to mechanical properties, placement, and need for* in situ. *Fortunately, these materials have been the focus of a great deal of research in recent years with the goal of improving restoration performance by changing the initiation system, monomers, and fillers and their coupling agents, and by developing novel polymerization strategies. Here, we review the general characteristics of the polymerization reaction and recent approaches that have been taken to improve composite restorative performance.*

Keywords - *Ceromers, Smart composites, Oemocers, Giomers*

INTRODUCTION

Of all the innovative esthetic materials available today composite restorative materials have assumed a thrust in restorative dentistry. Properly placed composite restorations provide an excellent alternative to traditional metallic posterior restorations. The search for an ideal esthetic material for restoring teeth has resulted in significant improvements in both esthetic materials and techniques for using them.**[1]**

Skinner in 1959 stated, " *The esthetic quality of a restoration may be as important to the mental health of the patient as the biological and technical qualities of the restoration are to his/her physical or dental health",* thus stressing the importance of esthetics as far as forty-five years back. The research in the field of esthetic and restorative dentistry led to the achievement of the long sought dream of virtually bonding any type of material to the tooth surface. The advances in the restorative materials and bonding techniques have changed the concept of **"EXTENSION FOR PREVENTION"** as **"RESTRICTION WITH CONVICTION."**

DEFINITION AND COMPOSITION

DEFINITION:

Composite material is a compound of two or more distinctly different materials with properties that are superior to or intermediate to those of the individual constituents. **ISO 4049** for polymer based filling, restorative and luting materials (ANSI / ADA No.27) describes two types and three classes of composites.**[2]**

COMPOSITIONS

1) Matrix- BisGMA, TEGDMA, and UDMA
2) Filler-. Glass fibers, Beads, Lithium aluminium silicates, Crystalline quartz, Barium glass, Strontium, Microfine silica
3) Coupling agent- Titanates Zirconates Organosilanes such as r-methacryloxypropyl silane
4) Initiator – accelerator system- Methacrylate monomers
5) Inhibitors- Butylated hydroxytoluene
6) Optical modifiers- Bis GMA and TEGDMA

ADVANCEMENTS

a) Ceromers
b) Smart composites
c) Oemocers
d) Giomers
e) Single crystal modified composites
f) Nanocomposites**[3]**

CEROMERS

The term ceromer stands for **Ceramic Optimized Polymer** and was introduced by Ivoclar to describe their composite Tetric Ceram**.** They are **microfilled hybrid resins or universal composite resins**. This material consists of a paste containing barium

glass, spheroidal mixed oxide, ytterbium trifluoride, and silicon dioxide (57 vol%) dimethacrylate monomers (Bis-GMA & urethane dimethacrylate). **[4]**

Uses:

- Ceromer can be used for veneers, inlay/onlay without a metal framework.
- Also can be used with Fiber Reinforced composite framework for inlays/onlay, crowns and bridges (3 unit) and for crown and bridges including implant restorations on a metal framework.

Ivoclar in cooperation with several universities has developed advanced polymer systems and ceramic fillers from which high performance Ceromers (**cer**amic **o**ptimized poly**mers**) have been produce.**[5]**

SMART COMPOSITES

Smart Composites are active dental polymers that contain bioactive amorphous calcium phosphate (ACP) filler capable of responding to environmental pH changes by releasing calcium and phosphate ions and thus become adaptable to the surroundings. These are also called as **Intelligent composites**.

This class of composite was introduced as the product **Ariston pHc** in 1998.Ariston is an ion releasing composite material. It releases functional ions like fluoride, hydroxyl, and calcium ions as the pH drops in the area immediately adjacent to the restorative materials, as a result of active plaque.**[6]**

ORMOCER

Recently a new material was made available for dental restoration therapy the **ORMOCER**. **Dr. Herbert Wolters** from Fraunhofer Institute for Silicate Research introduced this class of material in 1994.

ORMOCER, the acronym of **Organically Modified Ceramic** is a brand-new material for all filling indications in the anterior and posterior area which serve as an optimum and upto date replacement for amalgam, composite and compomers.

This class of material represents a novel inorganic-organic copolymers in the formulation that allows for modification of its mechanical parameters.**[7]**

Eg., **DEFINITE**

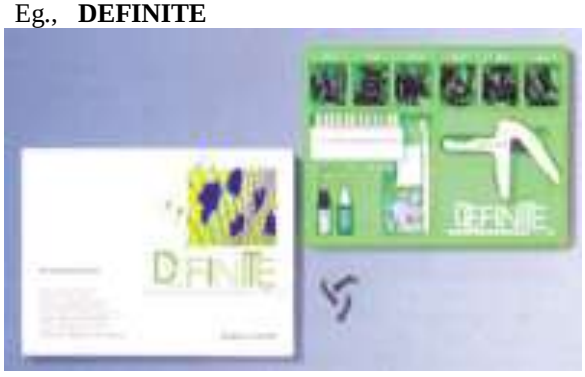


Figure 1

Giomers

Giomers are newly introduced hybrid aesthetic restorative materials for dental restorative therapy. Hybrid materials combining the technologies of glass ionomers and resin composites have been developed to help overcome problems of conventional GIC's such as moisture phase of GIC in the restorative and are also known as **PRG composites**.

Giomers employ the use of pre-reacted glass ionomer **(PRG)** technology to form a stable material. The fluroaluminosilicate glass in these materials is reacted with polyalkenoic acid in water prior to inclusions into silica-filled urethane resin Although, Giomer has been called a light cure, one pack glass-ionomer restorative by the manufacturer (Shofu Inc, Kyoto, Japan), it should be considered as light-cure composite as it does not have a significant acid-base reaction as part of its curing process and cannot set in the dark. This technology also differs from compomers, in which a variable amount of dehydrate polyalkenoic acid is incorporated into resin matrix and the acid does not react with the glass until water uptake occurs into the restoration.

Giomers come in a one-paste form. They are light polymerizing and require bonding agents for adhesion to tooth structure. Currently available giomer restoratives include **REACTMER** (Shofu Inc, Kyoto, Japan), **FL-BOND, BEAUTIFIL**

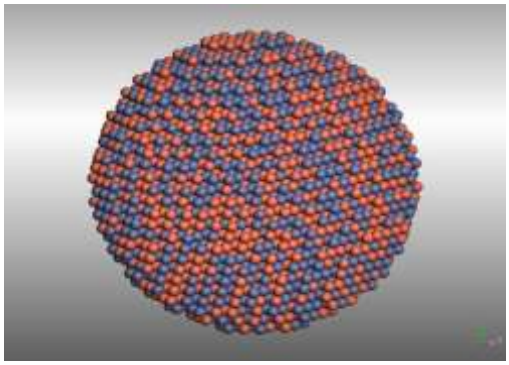
NANO COMPOSITES

These products are different from other types of composites in that they contain nano-sized fillers. One such product is **Filtek Supreme XT**, introduced in early 2003. Supreme purportedly uses unique nanofiller technology; that it is formulated with nanomer and nanocluster filler particles. As a result, Supreme is claimed to combine the strength of a hybrid and the polish of a microfill, a claim similar to that made by manufacturers of universal composites and reinforced microfills.

Composition:

Nanomers are discrete non-agglomerated and non-aggregated particles of 20-75 nm in size. Nanoclusters are loosely bound agglomerates of nano-sized particles. Nanotubes have remarkable tensile strength and could dwarf the improvements that carbon fibers brought to composites.

Nanomer



Nanocluster

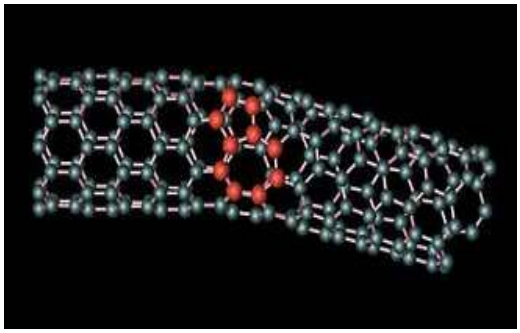


Figure 2

Advantages:

Superior translucency and esthetic appeal, excellent colour, high polish and polish retention.

- Superior hardness, flexural strength and modulus of elasticity.
- About fifty percent reduction in polymerization shrinkage.
- Excellent handling properties.**[8]**

Conclusion - Composite dental restorations represent a unique class of biomaterials with severe restrictions on biocompatibility, curing behavior, esthetics, and ultimate material properties. These materials are presently limited by shrinkage and polymerization-induced shrinkage stress, limited toughness, the presence of unreacted monomer that remains following the polymerization, and several other factors**.**

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