Composites – Materials science

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Requirements for dental restorative materials (Miller, 1896)

- Biocompatible coexiste with teeth and surrounding tissues;
- resistance to different categories of forces (mechanical, physical, chemical effects);
- bad heat and electric conduction;
- not sensitive for wetness;
- no form or volumetric changings;
- should match the surrounding tooth structure in shade, translucency, and texture;
- easy to manipulate and shape, insert and remove;
- good bonding strength to the tooth;
- affordable.

Composite:

a three dimensional combination of at least two chemically different materials with a distinct interface in between them

How recent composites „work”:

photosensitive agents in the matrix

↘

440-470nm (420-480nm)

photopolymerisation

↘

cross-linked monomers

Constitution of the matrix

- Monomer (Bis-GMA, UDMA);
- comonomer (TEGDMA, EDMA);
- iniciator;
- inhibitor (to stabilise);
- activators;
- colouring agents, pigments;
- photostabilisators;
- others: emmolients, optical modifiers, etc.

The matrix

- Initially: methacrylate base with glass globules and silicates;
- pulp irritant;
- significiant shrinkage;
- patent: BisGMA ~

  dr. Raphael Bowen,1962;
- more recent types…

The disperse phase

- Reinforces the soft matrix with crystals of quarz, glass fibers, silicates (Li, Ba, Sr, Zn, Sn);
- radio opacity → controlling marginal closings;
- esthetics.

concentration

☞mechanical properties

particule sizes

☞optical features

The silane phase

- Coupling agent improve the adherence of resin to filler particles' surfaces;
- chemically connects the hydrophobe matrix and the hydrophil disperse phase (bipolar molecule) with covalent bond.

Classifications of composites

- Based on method of polymerisation:

  chemically (self), light, dual cured;

- based on their consistency:

  flow, packable (condensable);

- based on the monomer type;

  classic and new type methacrylates, ormocers, silorane,

- based on filler particle size:

  macro (10-100 μm), midi (1-10 μm), mini (0,1-1 μm), micro (0,01-0,1 μm) nano (0,001-0,01 μm);

- based on filler particle distribution:

  homogenous, inhomogenous, heterogene, hybrid.

Subdivision according to Lutz (1983)

1. concentional (traditional) composites;
2. homogenous microfill composites;
3. inhomogenous microfill composites;
4. hybrid composites.