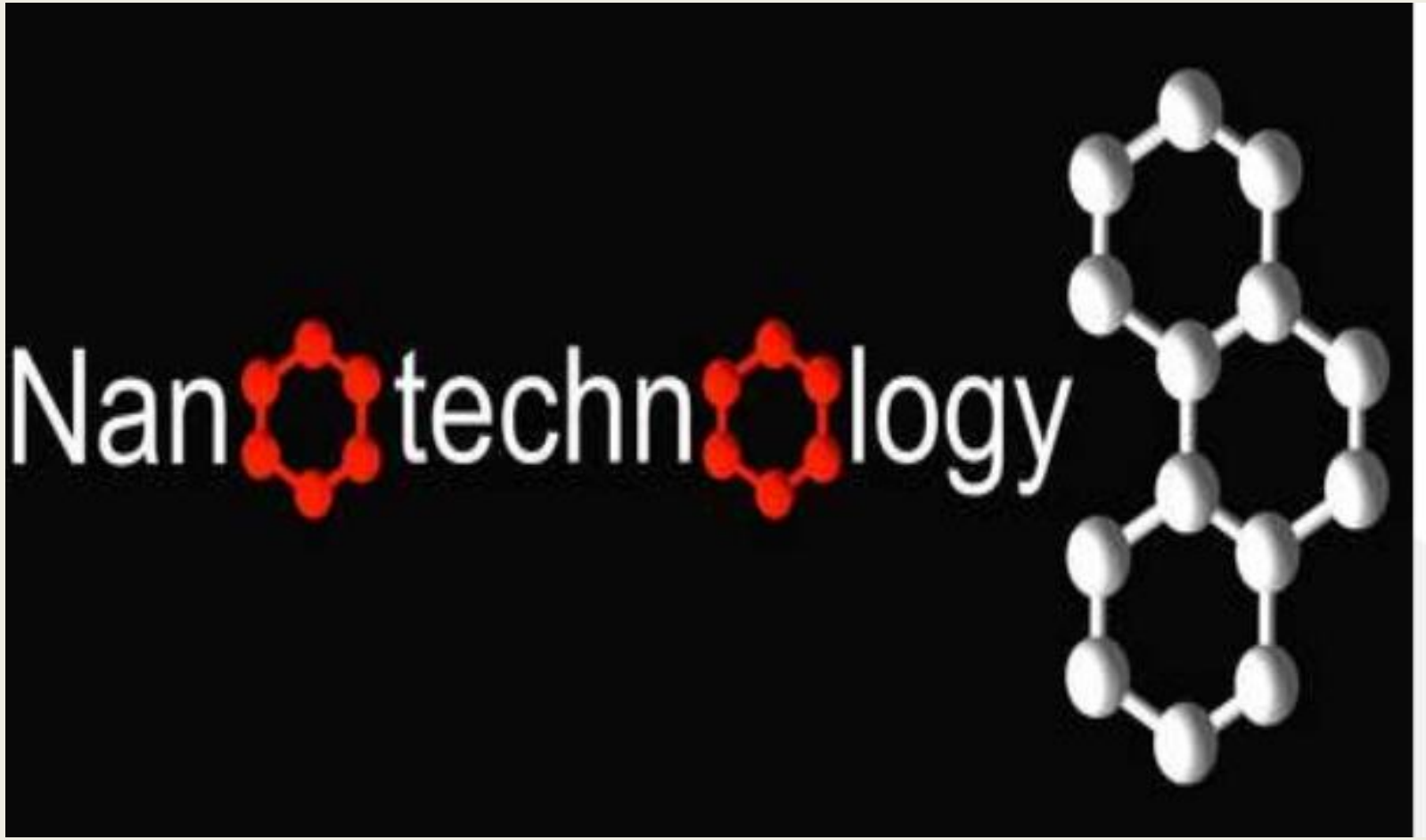


DONE BY:ASMAA M. KHAMAS

History

-The concept of nanotechnology was first elaborated in 1959 by Richard Feynman, a Nobel Prize winning physicist, in a lecture titled, “There’s plenty of room at the bottom”.

He ended the lecture concluding “this is a development which I think cannot be avoided”.

-but it was the Japanese scientist Norio Taniguchi of the Tokyo University of Science who first employed the term “nano-technology” in 1974

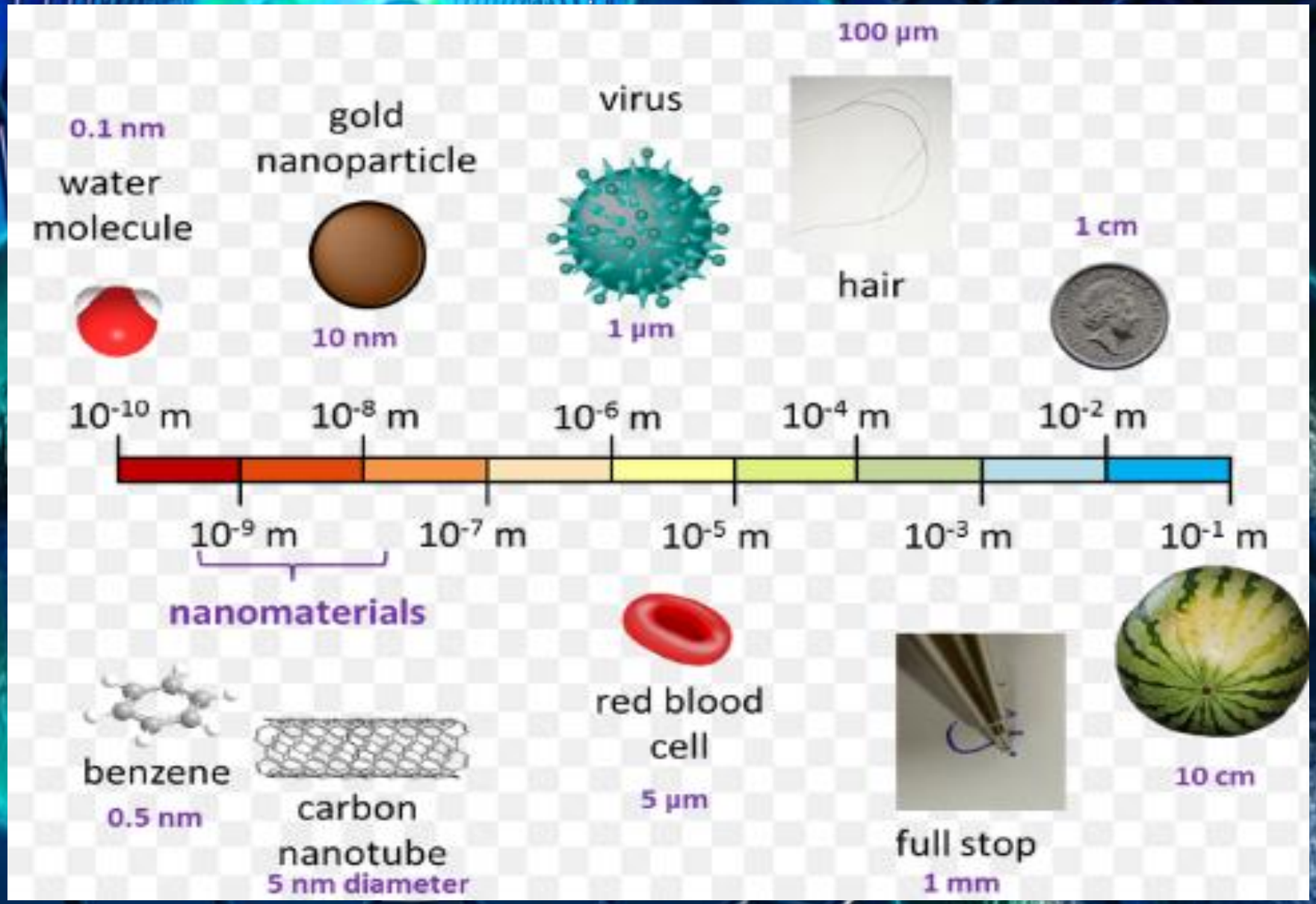
Introduction

Nanotechnology is the manipulation of matter on the molecular and atomic levels.

The word “nano” is said to be derived from the Greek word which stands for “dwarf”.

One nanometer is 1 billionth or 10−9 of a meter.

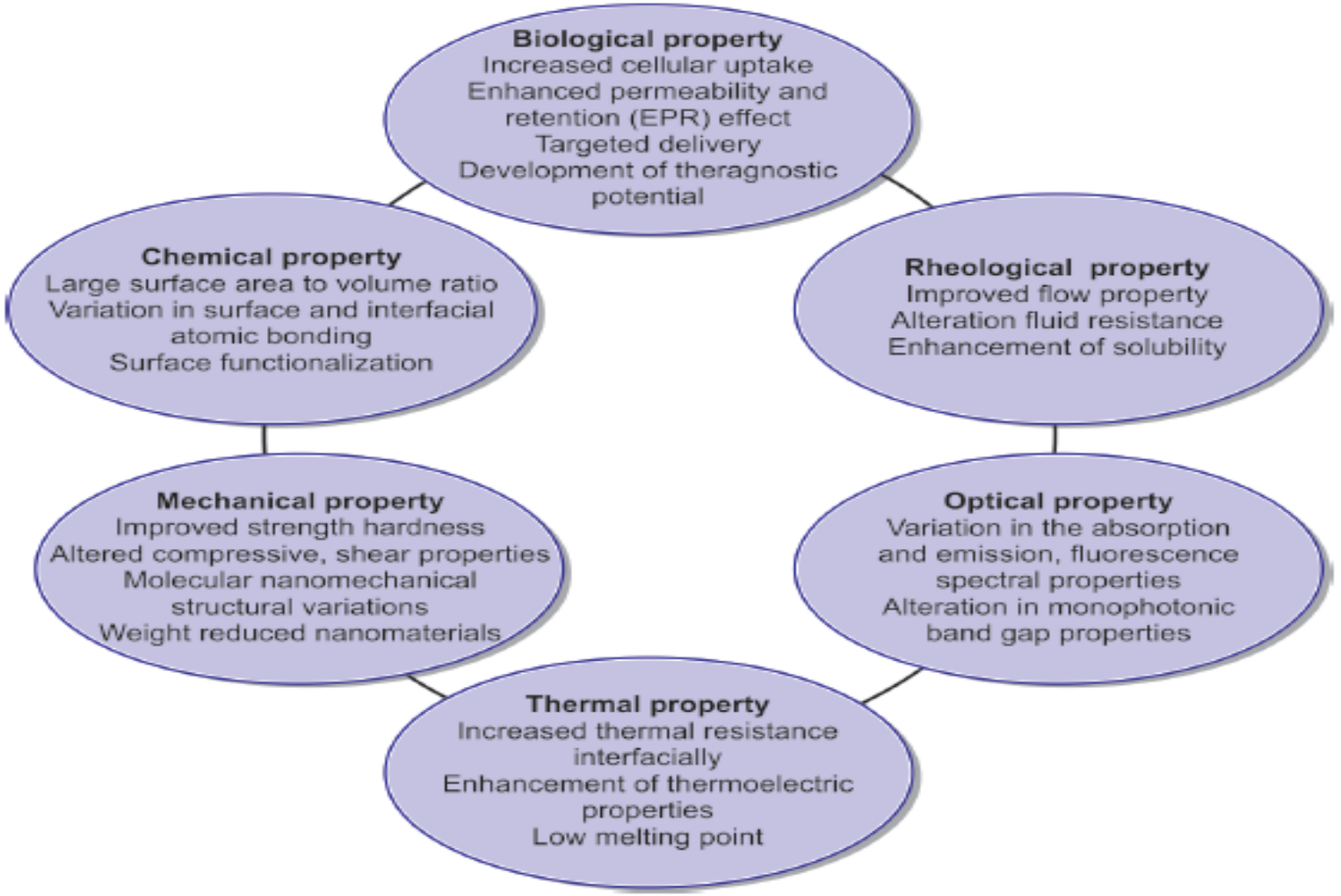
The comparative size of a nanometer to a meter is the same as the size of a marble to the size of the earth.


100 µm
0.1 nm
water molecule
gold nanoparticle
virus
hair
1 cm
10 nm
1 µm
10^{-10} m
10^{-8} m
10^{-6} m
10^{-4} m
10^{-2} m
10^{-9} m
10^{-7} m
10^{-5} m
10^{-3} m
10^{-1} m
nanomaterials
red blood cell
5 µm
benzene
0.5 nm
carbon nanotube
5 nm diameter
full stop
1 mm
10 cm

Nanoscale

The basic idea of nanotechnology is to employ individual atoms and molecules to construct functional structures.

Nanotechnology aims to manipulate and control particles to create novel structure with unique properties and promises advances in medicine and dentistry.



Approaches of Nanomaterials Synthesis

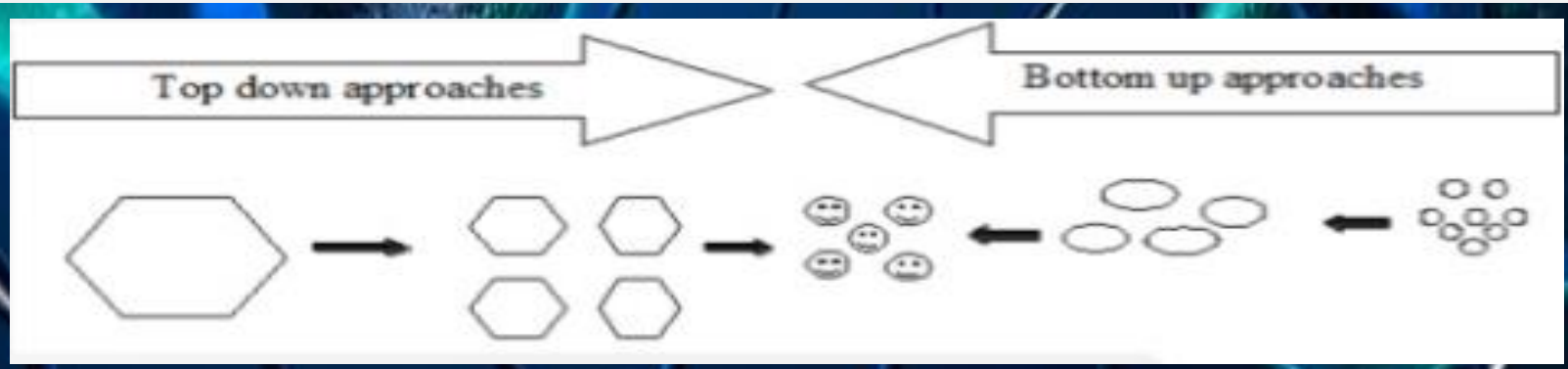
- Bottom-up approach is typically the construction of the material atom by atom, molecule by molecule.

  - complete stable and functional nanostructure, e.g. protein molecules ,

  -smaller

- Top-down approach is the procedural reduction in the dimensions of the bulk material till they attain a stable nanodimension structure.

  - The nanostructures formed through this approach will have more structural imperfections.



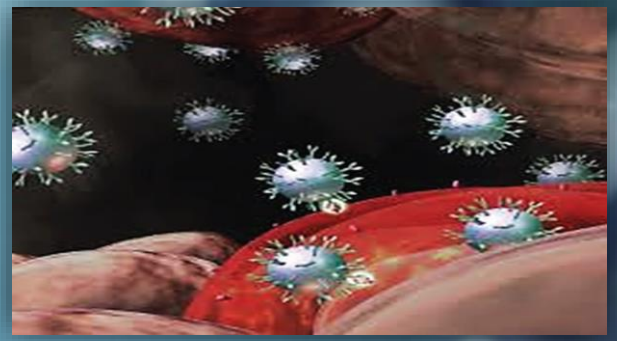

Nano
Dentistry
www.dentalreach.co

Nanodentistry includes:

- Nanorobotics: , they are theoretical microscopic devices that are measured on the scale of nanometers, They can be made to work under control by on-board computers capable of performing around 1000 or more computations per second.
- Nanodiagnostics: Diagnosis of Oral Cancer and Other Diseases
- Nanomaterials: nanocomposite ,… etc.

Local Anaesthesia

Nanoanaesthesia



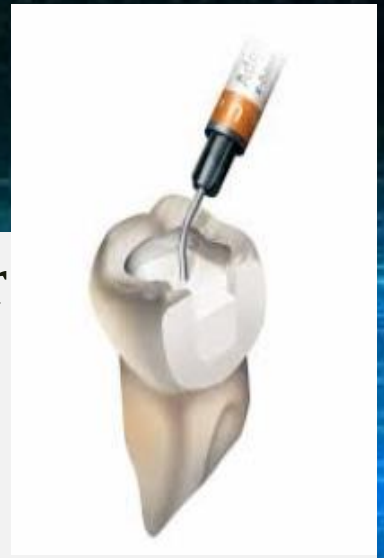
- Hypothetically, a colloidal suspension containing millions of active analgesic micron-size dental robots will be instilled on the patient's gingiva. After contacting the surface of the crown or mucosa, the ambulating nanorobots would reach the pulp via the gingival sulcus, lamina propria and dentinal tubules guided by chemical gradients and temperature differentials under the control of the dentist with the help of nanocomputer.
- Once installed in the pulp, these robots may shut down all sensitivity in any particular tooth that requires treatment.
- After the procedures are completed, these nanorobots may be manipulated to restore all sensation and relinquish control of nerve traffic and egress from the tooth by similar means used for ingress.

Nanoanaesthesia

Advantages:

- Greater patient comfort
- No anxiety, no needles
- Greater control of analgesia
- Fast and completely reversible
- No side effects and complications

Nanocomposite Restorations



Nanotechnology has enabled the production of nano dimensional filler particles, which are added either singly or as nanoclusters into composite resins.

- The size of the nanoparticles governs the optical properties, i.e. the nanoparticle size (~20 nm) is lesser than the visible light wavelength 400 nm to 800 nm ⟶ less opaque ⟶ anterior restorations

Nanofiller technology has enabled the production of nanofill composites by bringing together the esthetic features of microfill composites and the mechanical features of hybrid composites.

Nanocomposite advantages:

- Increased hardness.
- Improved flexural strength, toughness and translucency.
- Decreased polymerization shrinkage (50%).
- Exceptional handling properties.
- High polish retention
- Higher translucency giving it more lifelike appearance

* Nano based filler particles are help to improve the continuity in between the macroscopic (40 nm to 0.7 nm) natural tooth structure and nano-sized filler particle. This eventually results in a more natural and advanced interface.

Nano Light-curing Glass-Ionomer Restorative

by the incorporation of silica-zirconia nanofillers and nanoclusters and silica nanofillers in 2007, which has enhanced esthetic properties and retained the conventional properties of resin modified glass ionomer cements.

Advantages:

1. Excellent polish.
2. Super esthetics.
3. Enhanced wear resistance

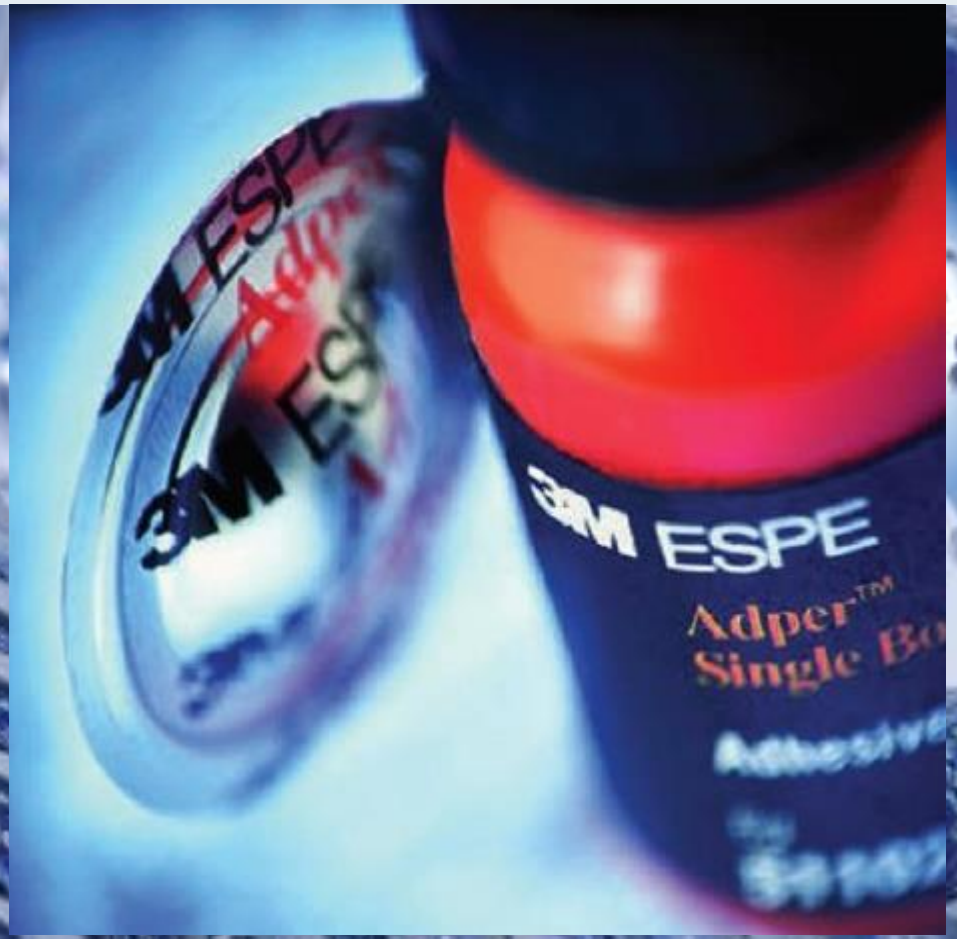
Nano Light-curing Glass-Ionomer Restorative

Clinical Indications:

- Primary teeth restoration.
- Transitional restoration.
- Small Class I restoration.
- Sandwich restoration.
- Class III and V restoration.
- Core build-up.

Nanosolution

Nanosolutions produce unique and dispersible nanoparticles which can be used in bonding agents. This ensures homogeneity, and is perfectly mixed every time. 10% 5 nm spherical silica is used as the filler.



Nanosolution

Nanofilled Self-Adhesive, Light-Cured Protective Coating

G-COAT PLUS is the only light-cured, protective clear coating formulated with adhesive monomer and nanofillers. One thin coat protects margins, prevents staining and provides a high gloss (comparable to intense polishing).


Surrounding enamel and existing sealant are etched

Fuji IX GP EXTRA shade B1 is placed

Contour occlusal anatomy


G-COAT PLUS is applied to all enamel, sealant and GIC surfaces

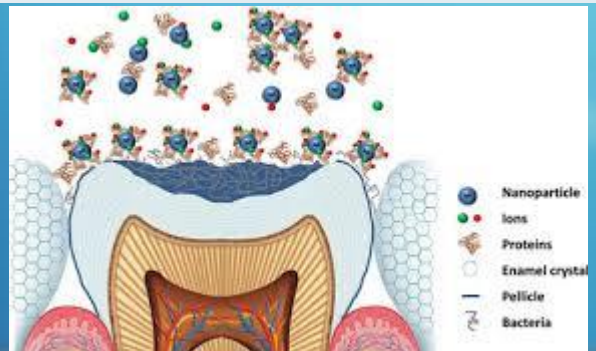

Light cure for 20 seconds


Completed restoration

Dentifrices

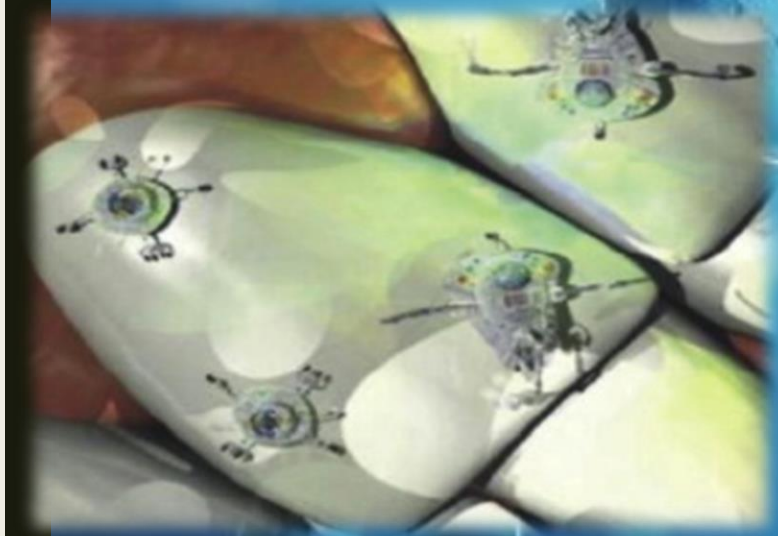
These Dentifrices form a protective coating on tooth enamel and even restore the surfaces of damaged teeth. Dentifrices like Microbrite has microhydrin(an alkaline antioxidant) which consists of molecular cages, 1-5 nanometer in diameter and degrade the organic food particles.

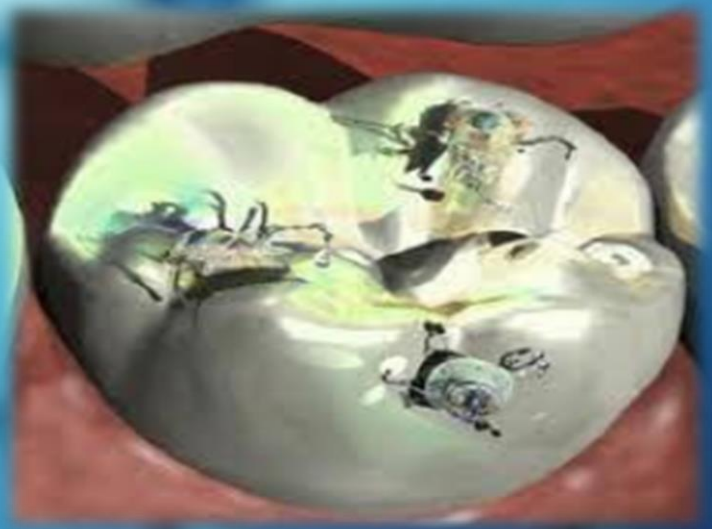
The Microhydrin in MicroBrite provides trillions of negatively charged ions that bind to the particles in your mouth for easy removal. The result is a cleaner, healthier, whiter smile.



Nanorobotic dentrifices

left on the occlusal surface of teeth can clean organic residues by moving throughout the supragingival and subgingival surfaces, metabolizing trapped organic matter into harmless and odorless vapors and performing continuous calculus debridement.. These nanorobots, crawling at 1-10 microns/sec, would be inexpensive, purely mechanical devices, that would safely deactivate themselves if swallowed, can move as fast as 1-10 μ/s .





Impression material

Nanofillers are integrated in vinyl polysiloxanes producing a unique addition silicone impression material. The material has better flow, improved hydrophilic properties, and enhanced detail precision.

Nano sterilizing solution

A new sterilizing solution following nanoemulsion concept has been developed. Nanosized oil droplets attack and destroy the pathogens.
E.g.: Eco Tru Disinfectant.

a nanoemulsion hospital-grade disinfectant and cleaner that effectively kills Hepatitis B, Hepatitis C, HIV and TB in five minutes, the company says.

Advantages:

- Broad spectrum
- Hypoallergic
- Noncoroding
- Does not stain fabric
- Require no protective clothing
- Environment friendly
- Compatible with various impression materials

Dental Biomimetics:

The most interesting venue for speculation on the nanorestoration of tooth structure is that of nanotechnology mimicking processes that occur in nature (biomimetics), such as the formation of dental enamel. fabrication of a new tooth in the dentist's office within the time and economic constraints of a typical dental office visit, complete dentition replacement therapy will become feasible soon. Chen et al utilizing nanotechnology simulated the natural biomineralization process to create the dental enamel, using highly organized micro architectural units of nano rod-like calcium hydroxyapatite crystals arranged roughly parallel to each other.

Challenges faced by Nanotechnology

- Precise positioning and manufacture of nanoscale parts.
- Cost-effective nanorobot mass manufacturing methods.
- Synchronization of numerous independent nanorobots.
- Biocompatibility concern.
- Financing and tactical concerns.
- Inadequate assimilation of clinical research.
- Social issues of public acceptance, ethics, regulation and human safety


THANK YOU!!