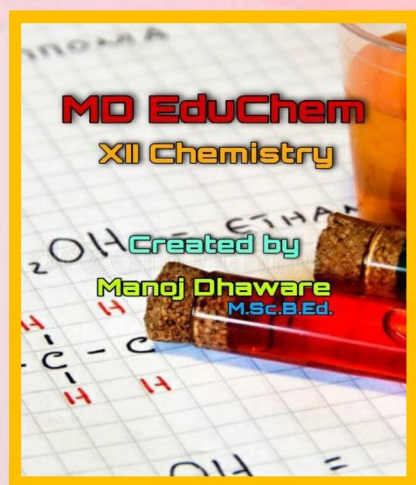
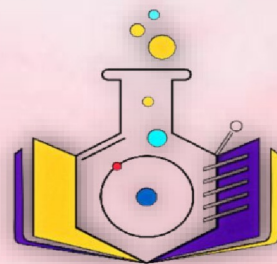


MD EduChem

Seed for new learning....

Mr. M. D. Dhaware

M.Sc. B.Ed.



XII Chemistry

Max. Marks: 3

Marks with option: 4

16. Green Chemistry & Nanochemistry

Contact

Mr. M.D. Dhaware

(Mob. No.  9960304794)

Visit

www.mdeduchem.com



CLICK HERE

16. Green Chemistry and Nanochemistry

Nanochemistry

16.1 Introduction: The concept of green chemistry was coined by **Paul T. Anastas**. Increase in population and the industrial revolution, energy crisis and environmental pollution are highlighted major problems in the 21st century. To minimize the problems of energy crisis and pollution, we have adapted green chemistry.

Green chemistry is an approach to chemistry that **aims to maximize efficiency and minimize hazardous effects on human health and environment.**

16.2 Sustainable development: 1) **Definition:** Sustainable development is the development that meets the needs of the present, without compromising the ability of future generations to meet their own need.

2) Sustainable development has been continued to evolve as that protecting the world's resources.

3) Green chemistry plays an important role in sustainable development.

16.3 Green Chemistry & their principles:

Definition: Green chemistry is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances to prevent environmental pollution.

Principles of Green chemistry:

1) Prevention of waste or by products: It gives priority for prevention of waste rather than cleaning up and treating waste after it has been created.

Illustration: i) Green chemistry develops the zero waste technology (ZWT) to produce minimum or zero waste in chemical synthesis.

ii) To use waste product of one system as the raw material for other system. For example, a) Bottom ash of thermal power station can be used as a raw material for cement and brick industry. b) Effluent coming out from cleansing of machinery parts may be used as coolant water in thermal power station.

2) Atom economy: i) It is a measure of the amount of atoms from the starting materials that are present in the useful products at the end of chemical process.

ii) Most of the atoms of the reactant are incorporated in the desired products and only small amounts of unwanted byproducts are formed and hence lesser problem of disposal.

Illustration: The concept of atom economy gives the measure of the unwanted product produced in a particular reaction.

16.9 Synthesis of nanoparticles (nanomaterials): Nanomaterial synthesized by physical, **chemical** and biological method.

Chemical Method: There are two approaches to the synthesis of nanomaterials in chemical method.

1) Top-Down approach: In the top-down approach, nanomaterials are synthesized from bulk material by breaking the material. The bulk solids are dis-assembled into finer pieces until they are constituted of only few atoms.

2) Bottom-Up approach : In the bottom-up approach, molecular components arrange themselves into more complex assemblies atom by atom, molecule by molecule and cluster by cluster from the bottom.

For example, synthesis of nanoparticles by **colloidal dispersion. (i.e. by sol-gel process)**

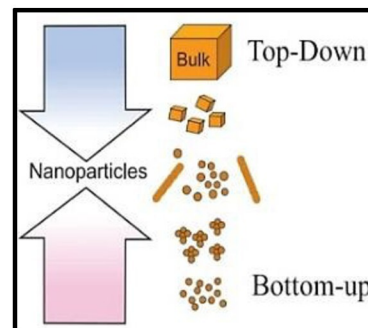


Fig. Scematic Illustration of Nanoparticles

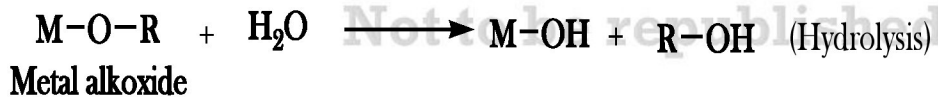
Sol-gel process:

1) A sol-gel process is based on inorganic polymerization reactions.

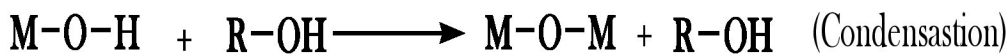
2) It is generally carried out at room temperature and includes four steps : **hydrolysis, polycondensation, drying and thermal decomposition.**

3) This method is widely employed to prepare oxide materials. The reaction involved in the sol-gel process can be described as follows:

i) Hydrolysis: In this step, there is formation of different stable solution of the alkoxide or solvated metal precursor.



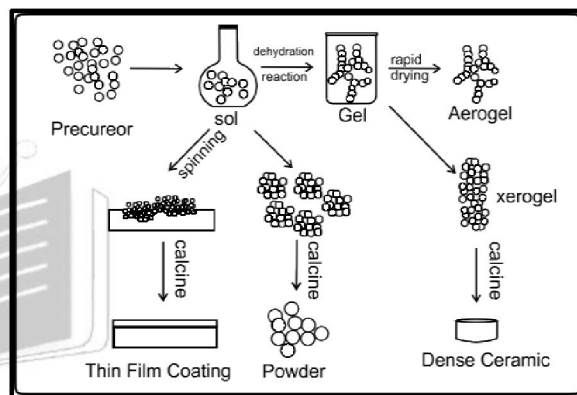
ii) Polycondensation: In this step there is gelation resulting from the formation of an oxide or alcohol-bridged network. (gel) by a polycondensation reaction.



iii) Aging : Aging of the gel means during that period gel transforms into a solid mass.

iv) Drying of the gel : In this step, water and other volatile liquids are removed from the gel network.

v) Thermal Decomposition (Dehydration): In this step, material is heated at temperatures up to 800 °C.



16.10 Analysis or characterization of nanomaterials: The synthesized material is analyzed by various analytical tools or techniques. The name of the technique and its use is described in the following table

16.15 Remember

- Visualize the size effect: Size difference between the earth and an apple is equal to the size difference between atoms (30 nm) and an apple.
- Paul T. Anastas (Born on May 16, 1962) is the director of Yale university's Center for green chemistry and green engineering. He is known as father of green chemistry.
- Does plastic packaging impact the food they wrap?

Ans. Phthalates leach into food through packaging so you should avoid microwaving food or drinks in plastic and not use plastic cling wrap and store your food in glass container whenever possible. Try to avoid prepackaging, processed food so that you will reduce exposure to harmful effect of plastic.

- A very highly useful application of nanochemistry is 'medicine'. A simple skin care product of nanochemistry is Sunscreen. **Sunscreen contains nanoparticles of Zinc oxide, (ZnO) and Titanium dioxide, (TiO₂).** These chemicals protect the skin against harmful UV (ultraviolet) rays by absorbing or reflecting the light and prevent the skin from damage.
- The term 'nanotechnology' was defined by Tokyo science University Professor, Nario Taniguchi in 1974.
- Invention of Scanning Tunneling Microscope (STM) in 1980, led to the discovery of fullerenes in 1986 and carbon nanotubes a few years later.
- Sol-gel processes are used in the motor vehicle industry to produce water repellent coatings for wind screens or exterior mirrors.
- Adipic acid is widely used in polymer industry.
- The pollution caused by nanotechnology is called **nano pollution**.
- Sols are dispersions of colloidal particles in a liquid. Colloids are solid particles with diameters of 1-100nm.
- A gel is interconnected rigid network with pores of sub-micrometer dimensions and polymeric chains whose average length is greater than a micrometer.

