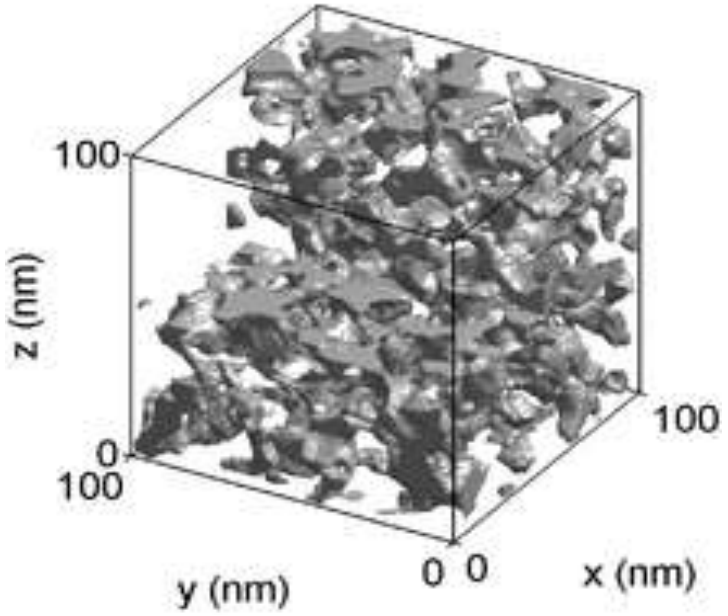
CHEMISTRY

The SOL-GEL Method

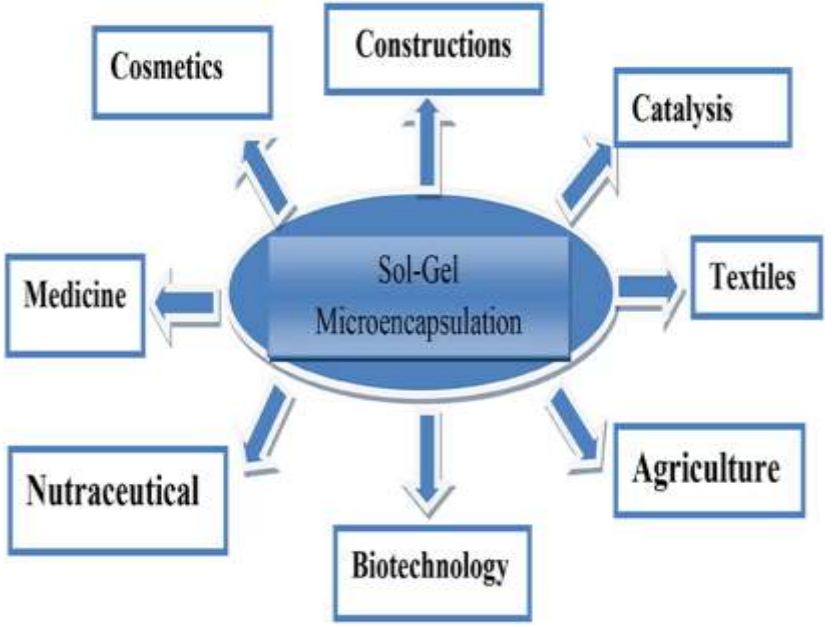


What is SOL-GEL method?

The sol-gel process is a more chemical method (wet chemical method) for the synthesis of various nanostructures, especially metal oxide nanoparticles. In this method, the molecular precursor (usually metal alkoxide) is dissolved in water or alcohol and converted to gel by heating and stirring by hydrolysis/alcoholysis. Since the gel obtained from the hydrolysis/alcoholysis process is wet or damp, it should be dried using appropriate methods depending on the desired properties and application of the gel

Uses of this method:

- The sol-gel method is a cost-effective method and due to the low reaction temperature there is good control over the chemical composition of the products.
- The sol-gel method can be used in the process of making ceramics as a molding material and can be used as an intermediate between thin films of metal oxides in various applications.
- The materials obtained from the sol-gel method are used in various optical, electronic, energy, surface engineering, biosensors, and pharmaceutical and separation technologies (such as chromatography).



Methods involved in SolGel process:

1)SOL FORMATION: Hydrolysis of metal organic reactant in an organic solvent that is miscible with water or inorganic salts in water results in formation of sol

$$M\text{-}O\text{-}R + H_2O \longrightarrow M\text{-}OH + R\text{-}OH \text{ (hydrolysis)}$$

2)GEL FORMATION: Condensation followed by polycondensation of sol results in the formation of the gel. Water condensation: hydrolysed species condense releasing water.

$$M\text{-}OH + HO\text{-}M \longrightarrow M\text{-}O\text{-}M + H_2O$$

Alcohol condensation: Hydrolysed species condense with unhydrolyzed species releasing alcohol.

$$M\text{-}O\text{-}R + HO\text{-}M \longrightarrow M\text{-}O\text{-}M + R\text{-}OH$$

Aging of gel during which polycondensation reaction occurs, can exceed 7 days is critical to the prevention of cracks in gels that have been cast.

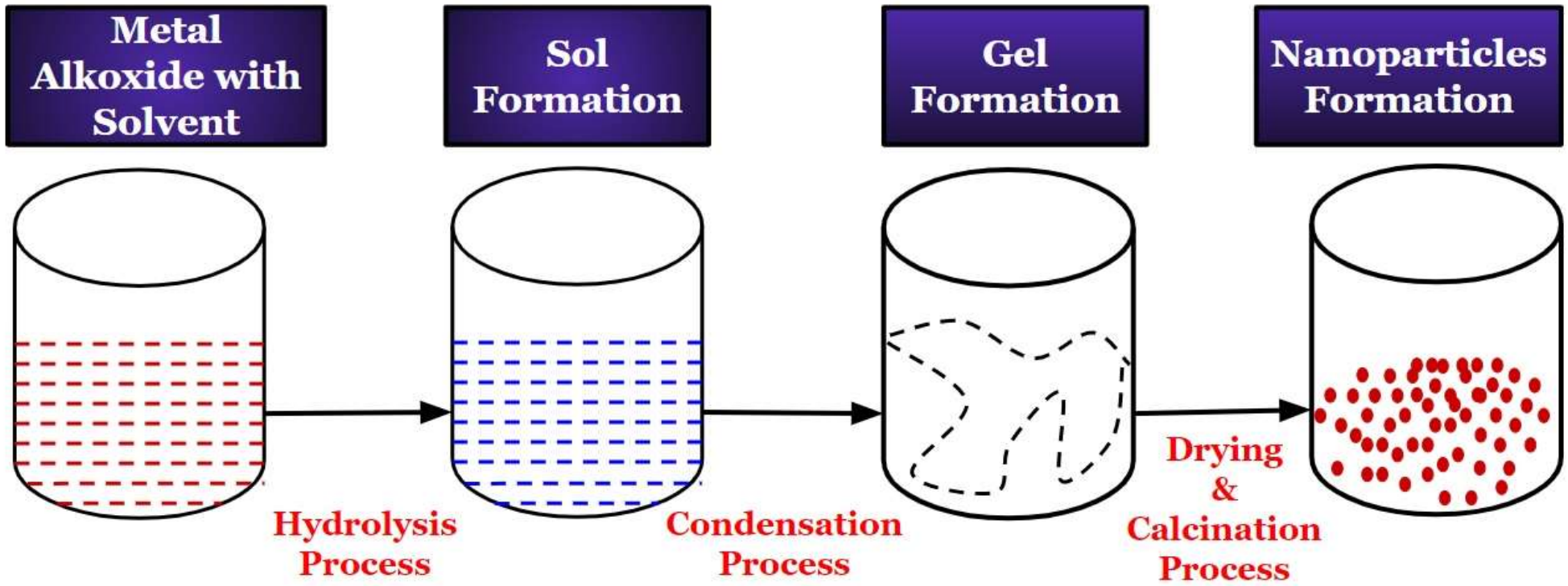
3)DRYING: It is nothing but removal of poreliquid Aerogels A silicon oxide low density aerogel Under hyper critical conditions, upon drying the network does not collapse and the aerogels are formed

Xerogel: Under ambient condition, upon thermal evaporation, shrinking of pores occurs and the xerogels are formed.

4)CALCINATION: During calcination, xerogel is heated up to 800 c. The pores of gel network are collapsed and remaining organic species are volatilized. The surface bound M-OH groups are removed, there by stabilizing the gel against rehydration. Calcination results in densification and decomposition of the gel.

5)HEAT TREATMENT: By heat treatment the material is shaped in to desired form such as films, fibres and nano sized powder. Subsequently it can be converted into Ceramic material.

Preparation Of Nanoparticles By Sol-Gel Method



Thank you