Fundamentals of nanotechnology

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Lec.9

2018-2019

3.Chemical vapour deposition (CVD)

Chemical vapour deposition (CVD) is a process where one or more gaseous adsorption species react or decompose on a hot surface to form stable solid products. The main steps that occur in the CVD process can be summarized as follows, Figure (4) :

1. Transport of reacting gaseous species to the surface.
2. Adsorption of the species on the surface.
3. Heterogeneous surface reaction catalyzed by the surface.
4. Surface diffusion of the species to growth sites.
5. Nucleation and growth of the film.
6. Desorption of gaseous reaction products and transportation of reaction products away from the surface.

3.Chemical vapour deposition (CVD)

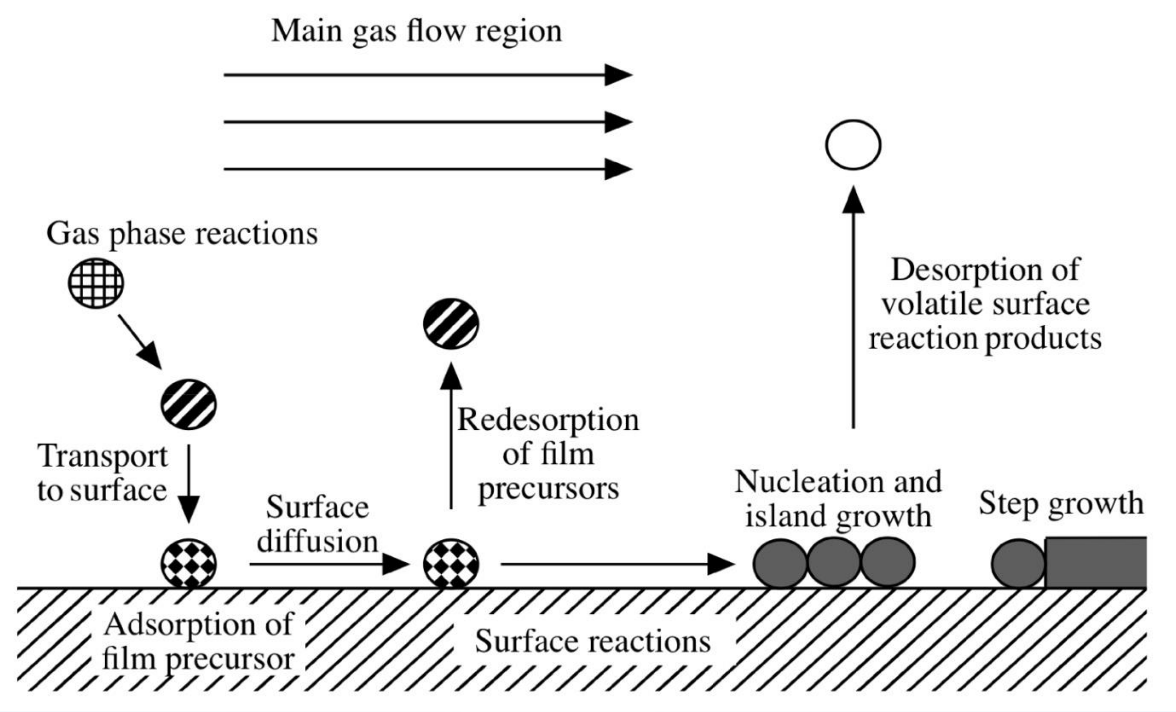

Figure 4:- Mechanism of CVD process.

3.Chemical vapour deposition (CVD)

Chemical vapour deposition is a more complicated method than PVD for the formation of thin films and coatings. The advantages of this process is its capability to produce highly pure and dense films or fine particles at reasonably high deposition rates, and the capability of coating complex-shaped components uniformly due to its non–line-of-sight nature. A variety of metallic, ceramic and semiconducting thin films are being deposited by CVD.
Depending on the activation sources for the chemical reactions, the deposition process can be categorized into thermally activated, laser-assisted and plasma-assisted CVD.

3.Chemical vapour deposition (CVD)

CVD process, is a process used to deposit thin films from a gas state (vapour) to a solid state on a substrate. Chemical reactions for plasma enhanced CVD are involved in the process, which occur after creation of a plasma of the reacting gases . The plasma (A plasma is any gas in which a significant percentage of the atoms or molecules are ionized) is generally created by RF (radio frequency) (AC) frequency or DC discharge between two electrodes, the space between which is filled with the reacting gases. While for thermally activated CVD process, the resistive heating of hot wall reactors gives sufficiently high temperatures for the dissociation of gaseous species. This leads to the heating of the entire substrate to a high temperature before the desired reaction is achieved.

4.Sol-gel process

The sol–gel processing method has been in use for many years for producing metal oxide and ceramic powders with high purity and high homogeneity. The sol-gel route offers a degree of control of composition and structure at the molecular level. The process involves the generation of a colloidal suspension ('sol'), which is subsequently converted to viscous (gel) and solid material.
Sol-gel method involves formation of '**sols**' in a liquid and connecting the sol particles (or some sub-units capable of forming a porous network) to form a network. By drying the liquid, it is possible to obtain powders, thin films or even monolithic solid.

4.Sol-gel process

After this, the formation of network which extends throughout the liquid medium is obtained to form a (**gel**), Gels are nothing but a continuous network of particles with pores filled with liquid.
Synthesis of sol - gel in general involves hydrolysis of precursors, condensation followed by polycondensation to form particles, gelation and drying process by various routes.
The precursors (starting chemicals) are to be chosen such that they have a tendency to form gels. The rates of hydrolysis and condensation reactions are governed by various factors such as:-
pH,
temperature,
molar ratio,
nature, concentration of catalyst, and
process of drying.
So, under proper conditions spherical nanoparticles are produced.

4.Sol-gel process

Sol Gel process can be indicate by different product forms in figure (5).

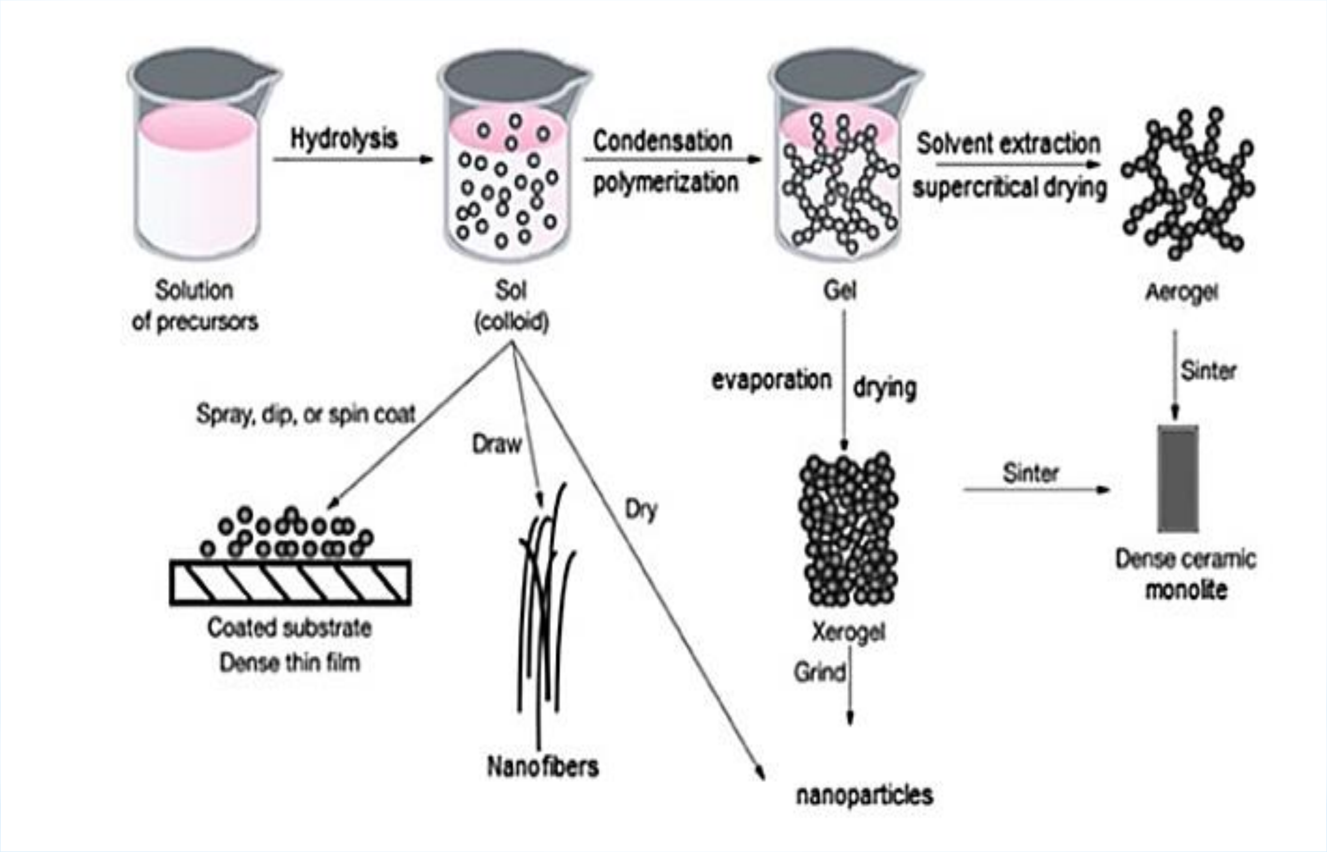

Fig. ٥ Schematic diagram of sol–gel method and its nanomaterials products