19CH101– ENGINEERING CHEMISTRY

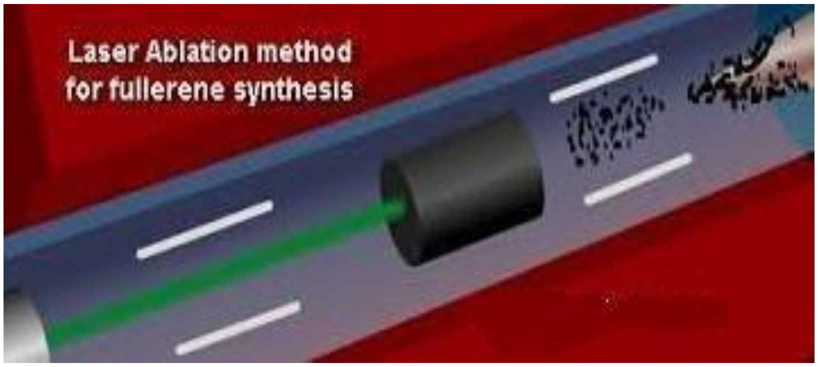
Unit-3 NANOCHEMISTRY

LASER ABLATION METHOD

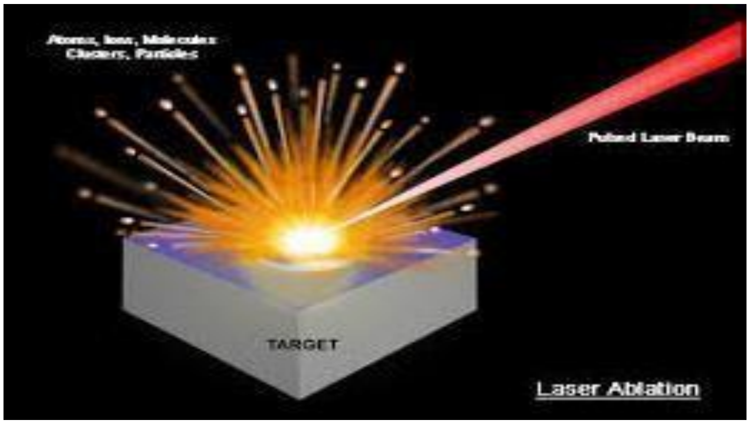
LASiS is the acronym for Laser Ablation Synthesis in Solution and it is a commonly used method for obtaining colloidal solution of nanoparticles in a variety of solvents.

In the LASiS method, nanoparticles are produced during the condensation of a plasma plume formed by the laser ablation of a bulk metal plate dipped in a liquid solution. LASiS is usually considered a top–down physical approach.

In the past years, laser ablation synthesis in solution (LASiS) emerged as a reliable alternative to traditional chemical reduction methods for obtaining noble metal nanoparticles (NMNp).



LASiS is a ‘‘green’’ technique for the synthesis of stable NMNp in water or in organic solvents, which does not need stabilizing molecules or other chemicals. So obtained NMNp are highly available for further functionalization or can be used wherever unprotected metal nanoparticles are desired.

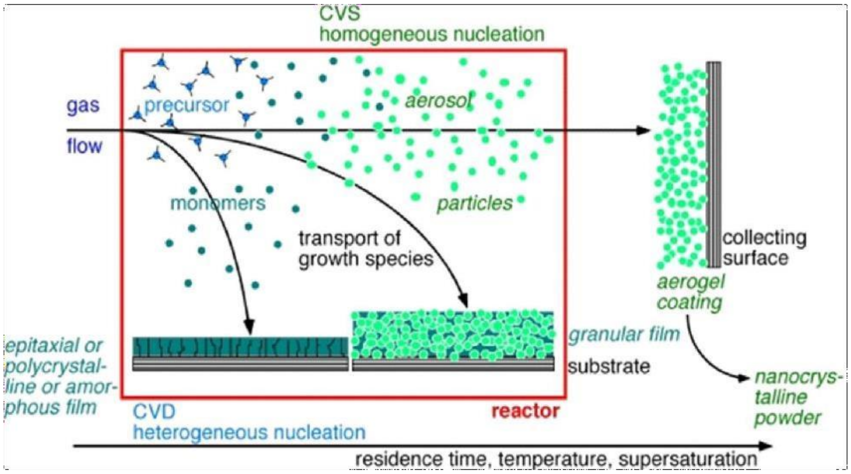


Chemical vapour deposition

Chemical Vapor Synthesis (CVS) is a modified Chemical Vapor Deposition (CVD) method where the process parameters are adjusted to form nanoparticles instead of film. The entire range of reaction regimes and co rrespo nding microstructures (epitaxial, polycrystalline, columnar, granular films and aerogel coatings as well as nanopowders) are shown in the below.

Both in CVD and CVS, precursors are metalorganics, carbonyls, hydrides, chlorides and other volatile compounds in gaseous, liquid or solid state. The major limitation of the CVS process is the availability of appropriate precursor materials. The energy for the conversion of the reactants into nanoparticles is supplied in hot wall (external furnace), flame (reaction enthalpy), plasma (microwave or radio frequency) and laser (photolysis or pyrolysis) reactors.

The most important process parameters determining the quality and usability of the nanopowders are the total pressure (typical range from 100 to 100000 Pa), the precursor material (decomposition kinetics and ligands determining the impurity level), the partial pressure of the precursor (determining the production rate and particle size), the temperature or power of the energy source, the carrier gas (mass flow determining the residence time) and the reactor geometry.



The nanoparticles are extracted from the aerosol by means of filters, thermophoretic collectors, electrostatic precipitators or scrubbing in a liquid. Modifications of the precursor delivery system and the reaction zone allow the synthesis of pure oxides, doped oxides, coated nanoparticles, functionalized nanoparticles and granular films.