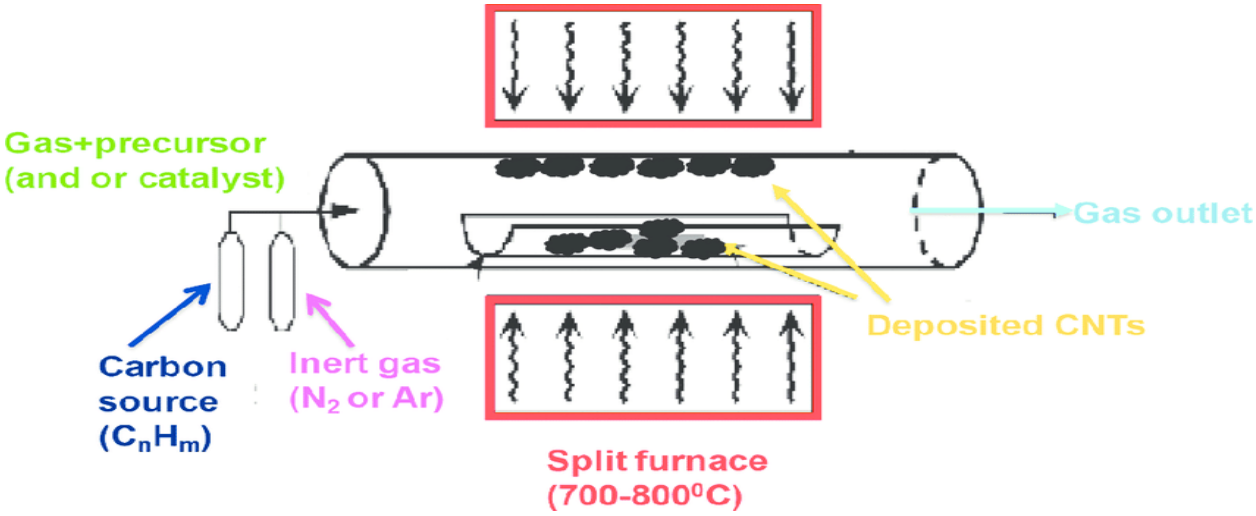
Chemical vapour deposition method

The process involves the formation of nanomaterials from the gas phase at elevated temperature. The solid material are converted into gas phase and deposited as nanomaterials



- It consists of high temperature vacuum furnace .It has a provision for maintaining the inert atmosphere
- The solid substrate contains catalyst such as Fe, Co and Ni supported on MgO or Al_2O_3
- Hydrocarbons such as methane ,ethylene, acetylene and nitrogen gas are connected to the furnace
- Carbon atoms are produced by decomposition of hydrocarbons at 1000°C ,Condenses and forms as nanotubes on the surface of solid surface
- The catalyst plays an important role in the formation of carbon nanotubes
    - It is a process of chemically taking a volatile compound of a material with other gases, to produce a non-volatile solid that deposits automatically on a suitably placed substrate
    - CVD reaction requires activation energy to proceed. This energy can be provided by several methods

(a) Thermal CVD

- In thermal CVD, the reaction is activated by high temperature above 900^0C.
- Typical apparatus comprises of gas supply system, deposition chamber and an exhaust system.

(b) Plasma CVD

- In plasma CVD, the reaction is activated by plasma at temperature lies in between 300^0 - 700^0C.

(c) Laser CVD

- In laser CVD, pyrolysis occurs when laser thermal energy of laser heats falls on an absorbing substrate.

(d) Photo-laser CVD

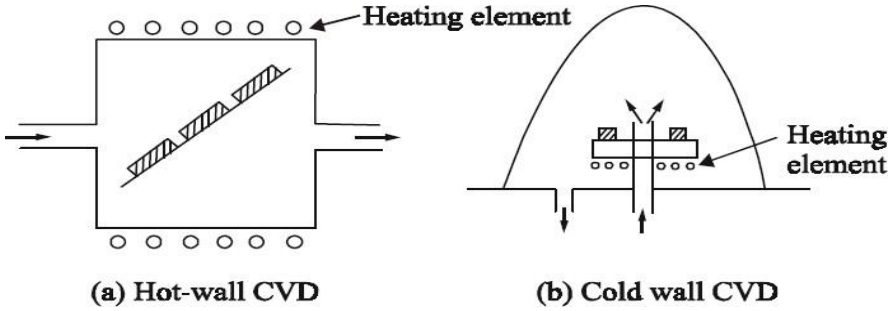
- In photo-laser CVD, the chemical reaction is induced by ultra violet radiation, which has sufficient photon energy, to break the chemical bond in the reactant molecules.

CVD Reactor

The CVD reactors are of generally two types

1. Hot-wall CVD
2. Cold-wall CVD

1. Hot-wall CVD reactors are usually tubular in form, and heating is accomplishedby surrounding the reactor with resistance elements.
2. But in cold-wall CVD reactors, substrates are directly heated inductively bygraphite Sub sectors, while chamber walls are air (or) water-cooled.



(a) Hot-wall CVD (b) Cold wall CVD

CVD Reactors

Advantages

- High purity nanomaterials are produced
- Low cost
- Mainly responsible for carbon nanotubes formation

Disadvantages

- Requires high temperature
- Complex process
- Toxic gases are released during the process
- Not ecofriendly in nature