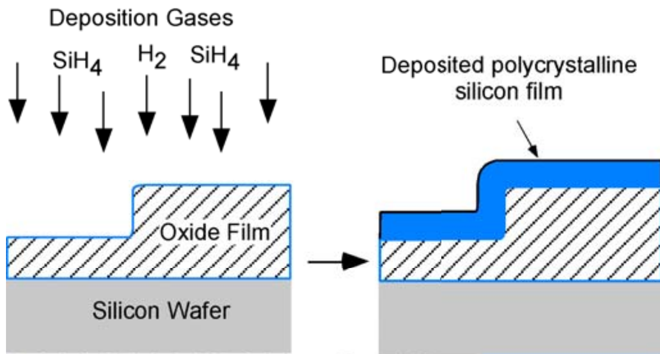
(3) Deposition



Drawing of wafer surface showing deposition process to form a silicon film on top of an oxide layer.

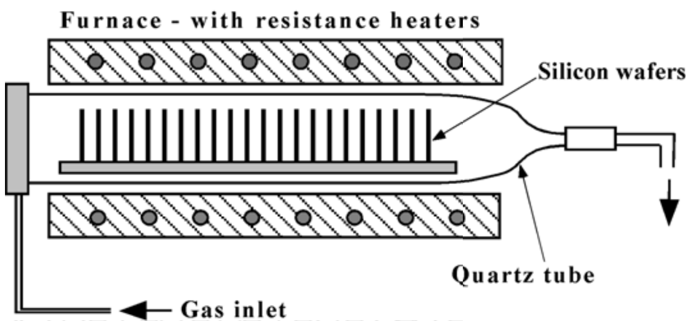


Diagram of chemical vapor deposition (CVD) tool.

A silicon CVD deposition tool in SNF, with multiple furnace tubes

Deposition is used in nanofabrication processes to deposit or add thin films on the wafer surface. Two major categories of deposition techniques are chemical vapor deposition (CVD) and physical vapor deposition (PVD).

In the CVD method, reactant gases flow into the chamber containing the wafers. High temperatures (400-1000ºC) are used to initiate chemical reactions between the reactants that cause a film to be deposited on the wafer surface. The deposition can also be done in a plasma, which is composed of energetic gas species. This allows the deposition to occur at lower temperatures. Silicon dioxide, silicon nitride, and polycrystalline silicon films are commonly deposited by CVD in SNF. Related to CVD is thermal oxidation which is done in some of the tubes. Here oxygen or water vapor is used as the gas species. These react with Si already on the wafer, or with the Si wafer itself, to form a high quality silicon dioxide film.

In the PVD method, physical rather than chemical processes are utilized. In one such technique, called **sputter deposition**, a plasma is used to knock off, or “sputter,” atoms from a “target” of solid source material. These atoms then travel to the wafer surface and deposit as a film. In another PVD technique called **evaporation** the source material is heated until it vaporizes, which then condenses on the wafer and forms a film. PVD is mostly used in SNF to deposit metal films.