CLASSIFICATION OF INFILTRATION
METHODS OF CERAMIC COMPOSITES
FABRICATION

All Infiltration technique incorporate the following stages of fabrication:

- **Fabrication of preform.** A preform of the required shape is prepared by laying-up and molding the fiber reinforcing phase.

- **Deposition of Interphases.** The fibers are coated with interphases during either the filament production or after the preform fabrication.

- **Infiltration.** The fibrous preform is infiltrated with a preceramic fluid. The fluid contains either ceramic matrix particles (slurry) or a substance, which may be converted into a ceramic as a result of chemical reaction.

- **Thermal processing.** Ceramic matrix forms in the space between the fibers when the preceramic fluid incorporated into the reinforcing structure is heated.

Infiltration techniques employ different types of the fluids and the processes of conversion of the fluid into a ceramic:

- **Polymer Infiltration and Pyrolysis (PIP).** Ceramic matrix is formed from a low viscosity preceramic organo-metallic polymer infiltrated into a preform as a result of pyrolysis.

- **Chemical Vapor Infiltration (CVI).** A preceramic gaseous precursor (vapor) infiltrates into the fiber reinforcing preform and converts into ceramic as a result of chemical decomposition.

- **Reactive Melt Infiltration (RMI).** The preform is infiltrated with a liquid metal, which produces ceramic matrix when reacting with a surrounding substance.
- **Liquid Silicon Infiltration (LSI)**. Silicon carbide matrix forms during the reaction of molten silicon infiltrated into the preform with the porous carbon.

- **Direct Melt Oxidation (DIMOX)**. Ceramic matrix is produced from a molten metal (commonly aluminum) oxidized by the surrounding air.

- **Slurry Infiltration**. The matrix is formed from a slurry containing fine ceramic particle, which infiltrates into the preform and converts into ceramic after drying and hot pressing.

- **Sol-Gel Infiltration**. A sol preceramic precursor infiltrates into the preform, undergoes polymerization (gelation) and then is converted into a ceramic at an elevated temperature.

- **Combined infiltration methods**.
  - **Slurry Infiltration + Polymer Infiltration and Pyrolysis (PIP)**. Infiltration of the preform with a preceramic polymer blended with fine ceramic particles (slurry) followed by pyrolysis.
  
  - **Slurry Infiltration + Liquid Silicon Infiltration (LSI)**. The fiber reinforcing preform is infiltrated with a slurry containing SiC particles, which fill part of the free space. The preform is then infiltrated with molten silicon reacting with the surrounding carbon and forming silicon carbide.
  
  - **Chemical Vapor Infiltration (CVI) + Liquid Silicon Infiltration (LSI)**. A porous carbon preform is prepared by CVI method and then it is infiltrated with molten silicon, which reacts with the surrounding carbon and forms SIC matrix.
  
  - **Chemical Vapor Infiltration (CVI) + Polymer Infiltration and Pyrolysis (PIP)**. The SiC matrix is partially fabricated by CVI and then infiltrated with a preceramic polymer and pyrolyzed.