ATHARVA
COLLEGE OF ENGINEERING

# Department of Humanities and Applied Sciences

# APPLIED CHEMISTRY (Semester I)

Dr. Priyanka Badani
Assistant Professor

# CHAPTER : INTRODUCTION TO COMPOSITE MATERIALS

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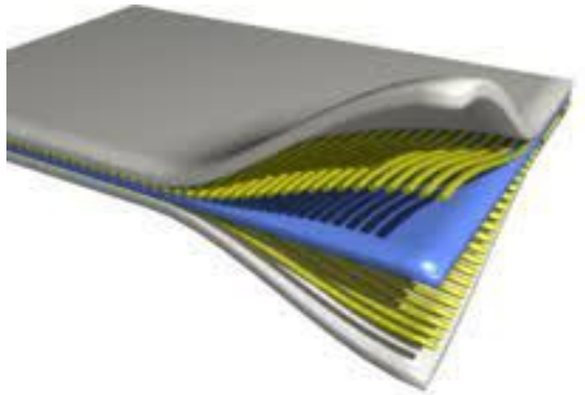
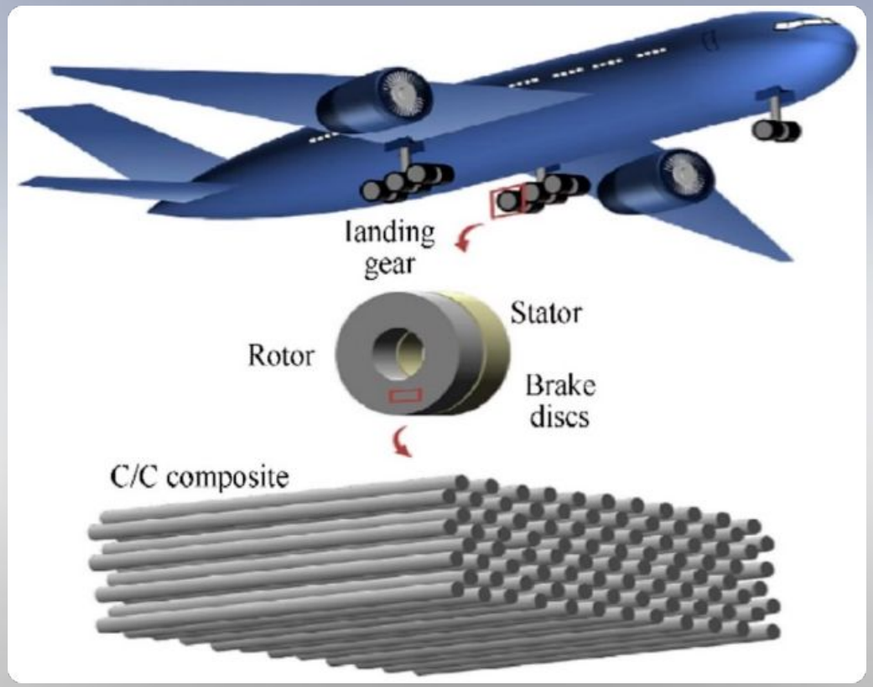


# DEFINITION OF COMPOSITE MATERIALS

Composite materials are made up of a matrix phase and a dispersed phase. The matrix phase is the continuous base material, while the dispersed phase is the reinforcing material embedded within the matrix. Together, they create a synergistic material with improved strength, stiffness, and other desirable properties.

https://youtu.be/6HVYX8FRSGA



# CHARACTERISTICS OF COMPOSITE MATERIALS

- High specific strength
- High Specific stiffness
- Low density
- Corrosion resistance
- Wear resistance
- Fatigue resistance
- Creep resistance

Link:
https://www.youtube.com/watch?v=04K0bLwCDdM

# CONSTITUENTS OF COMPOSITES MATERIALS

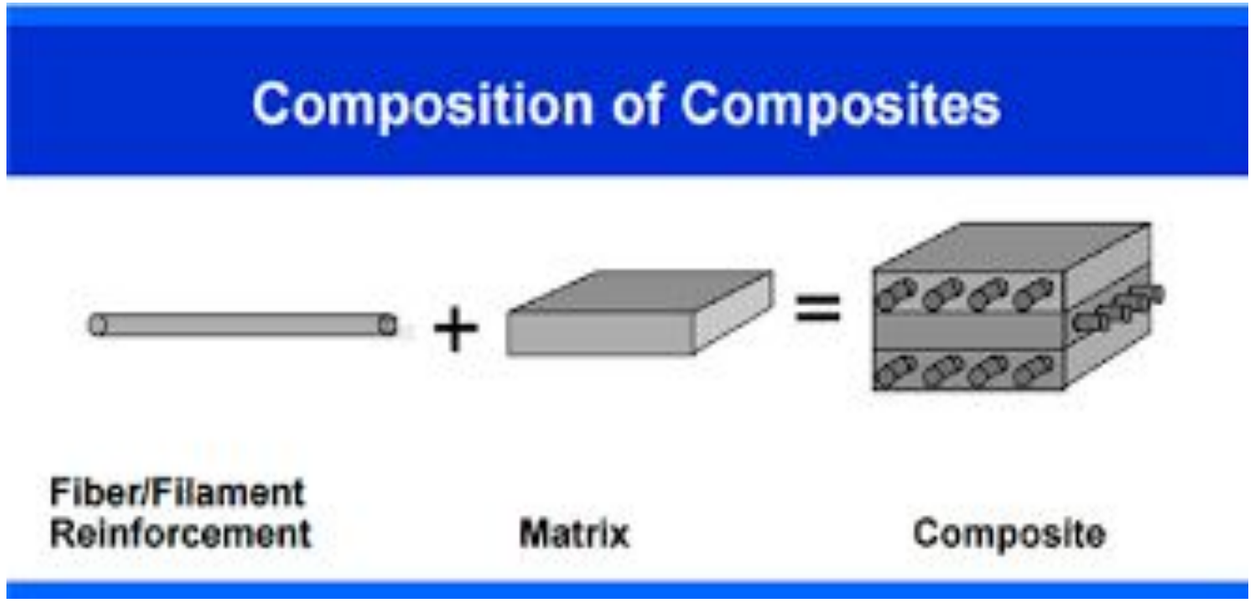
What are the constituents constituents in a composite composite material?

1.Reinforcement fibre : discontinuous stronger harder

2. Matrix: Continuous

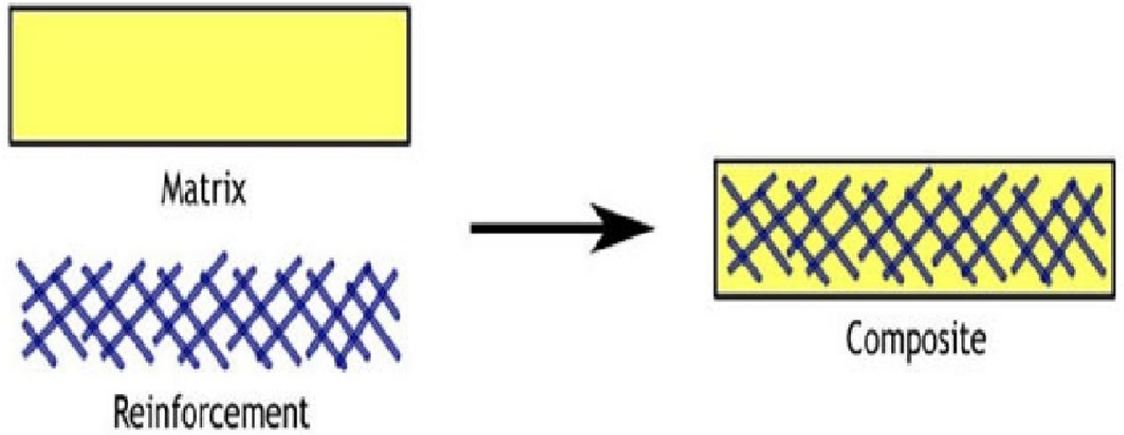
# FUNCTIONS OF A REINFORCEMENT FIBRE

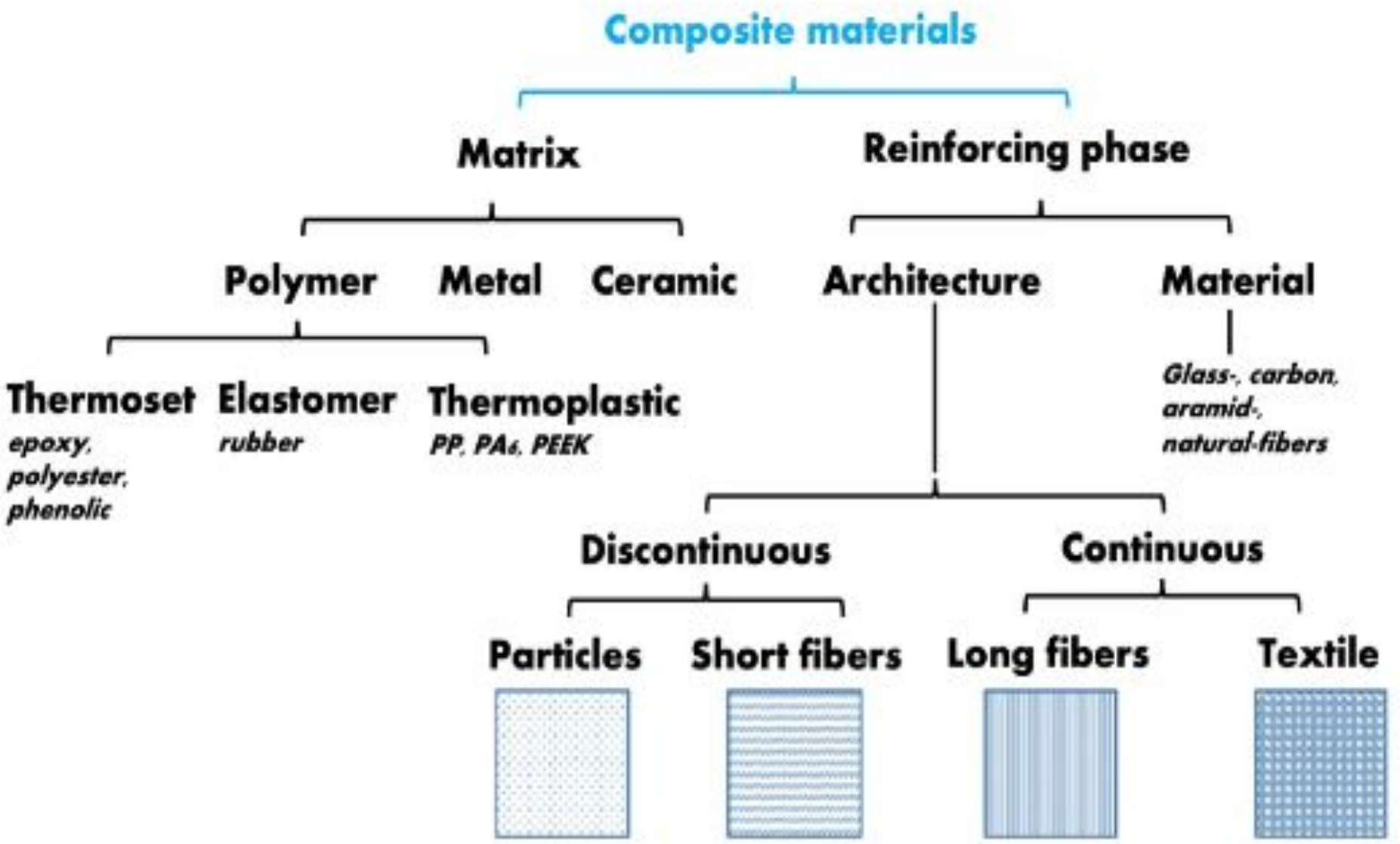
- Contribute desired properties
- Load carrying
- Transfer the strength to matrix



# FUNCTIONS OF A MATRIX

- Holds the fibres together
- Protects the fibres from environment
- Protects the fibres from abrasion (with each other)
- Helps to maintain the distribution of fibres
- Distributes the loads evenly between fibres
- Enhances some of the properties of the resulting material and structural component
- Provides better finish to final product




Composite materials
Matrix
Reinforcing phase
Polymer
Metal
Ceramic
Architecture
Material
Thermoset
epoxy, polyester, phenolic
Elastomer
rubber
Thermoplastic
PP, PA6, PEEK
Glass-, carbon, aramid-, natural-fibers
Discontinuous
Continuous
Particles
Short fibers
Long fibers
Textile

# Functions of Matrix Phase and Dispersed Phase

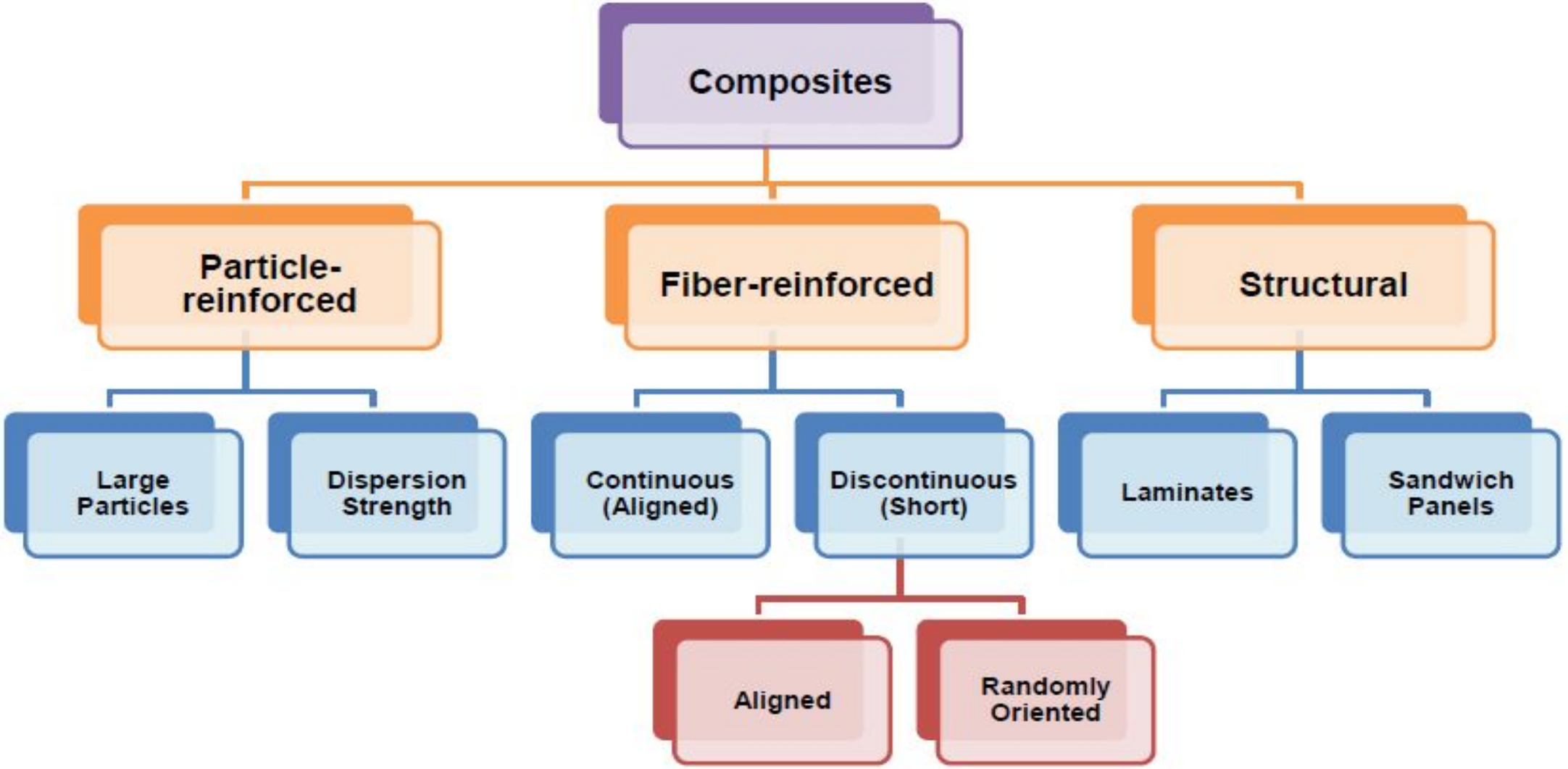
**Matrix Phase**

The matrix phase transfers loads, protects the dispersed phase, and keeps the components of the composite together.

**Dispersed Phase**

The dispersed phase provides strength, stiffness, and other desired properties to the composite, enhancing its overall performance.

# CLASSIFICATION OF COMPOSITES



# A) PARTICLE -REINFORCED COMPOSITES

1)Large -particle

- Particle-matrix interactions cannot be treated at atomic if molecular level
- Particle size : 1-50 μM
- Concentration : 15-40 % by volume.
- The particulate phase is harder and stiffer than the matrix.
- The cost is moderate as the particles as less expensive than the matrix.

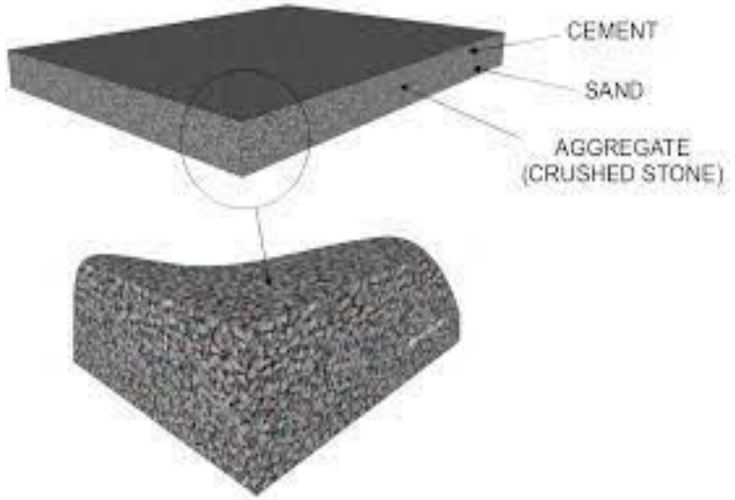
# A) PARTICLE -REINFORCED COMPOSITES

## Reinforced Plastics

- **Reinforcement Particles:** Glass fibers or mineral fillers like talc or calcium carbonate.
- **Matrix:** Various polymers such as epoxy, polyester, or vinyl ester.

## Concrete (Cement-Based Composites)

- **Reinforcement Particles:** Aggregate particles like sand, gravel, or crushed stone.
- **Matrix:** Cement paste.




# B) DISPERSION-REINFORCED COMPOSITES

- In this composite, particles are of 0.01-0.1 μm in size. Strengthening occurs as a result of dislocation motion hindrance.
- It is similar to that of precipitation hardening in metals.
- Matrix bears the major portion of the applied load, while dispersoids obstruct the motion of dislocations.

# A) DISPERSION-REINFORCED COMPOSITES

**Aluminium-Based Dispersion-Strengthened Composite**

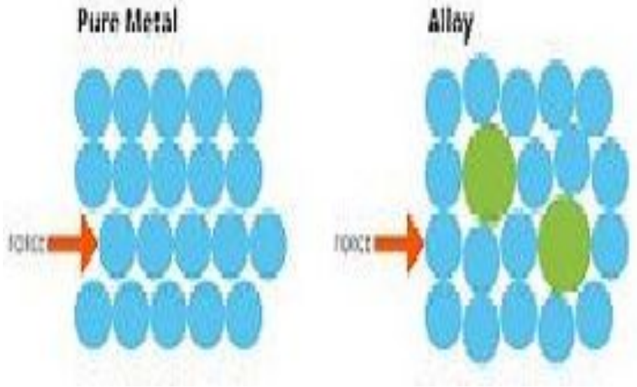
**Matrix:** Aluminum or an aluminum alloy

**Dispersed Particles:** Fine ceramic particles such as aluminum oxide ($Al_2O_3$), silicon carbide (SiC), or thorium oxide ($ThO_2$)

**Steel-Based Dispersion-Strengthened Composites**

**Matrix:** Various steel alloys

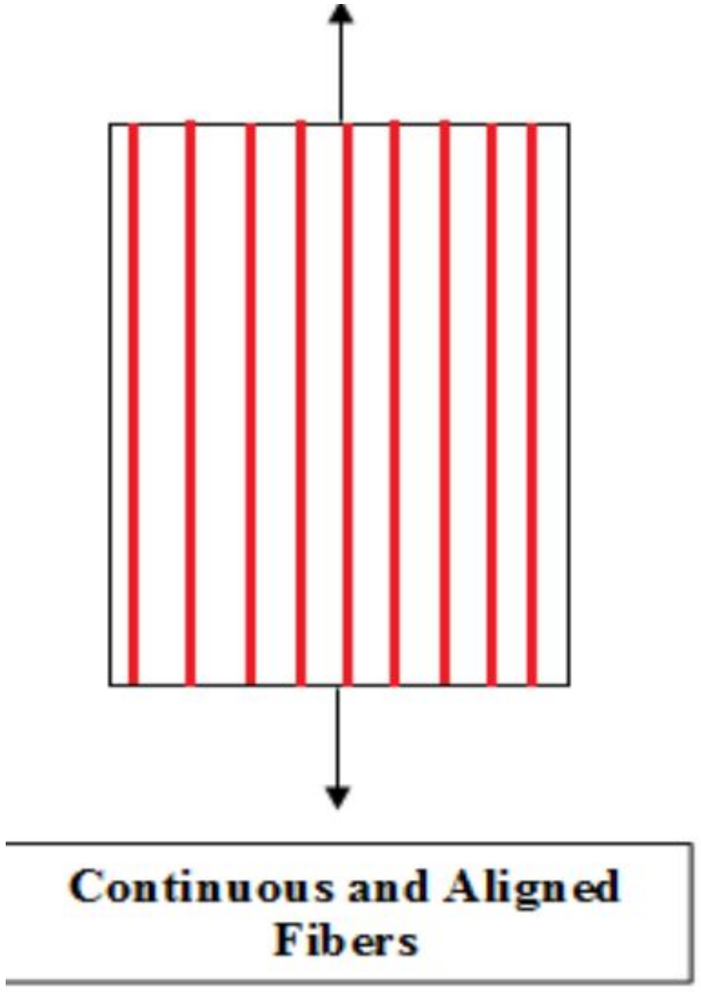
**Dispersed Particles:** Oxides (e.g., $Al_2O_3$, $Y_2O_3$), carbides (e.g., WC, TiC), or nitrides (e.g., TiN)



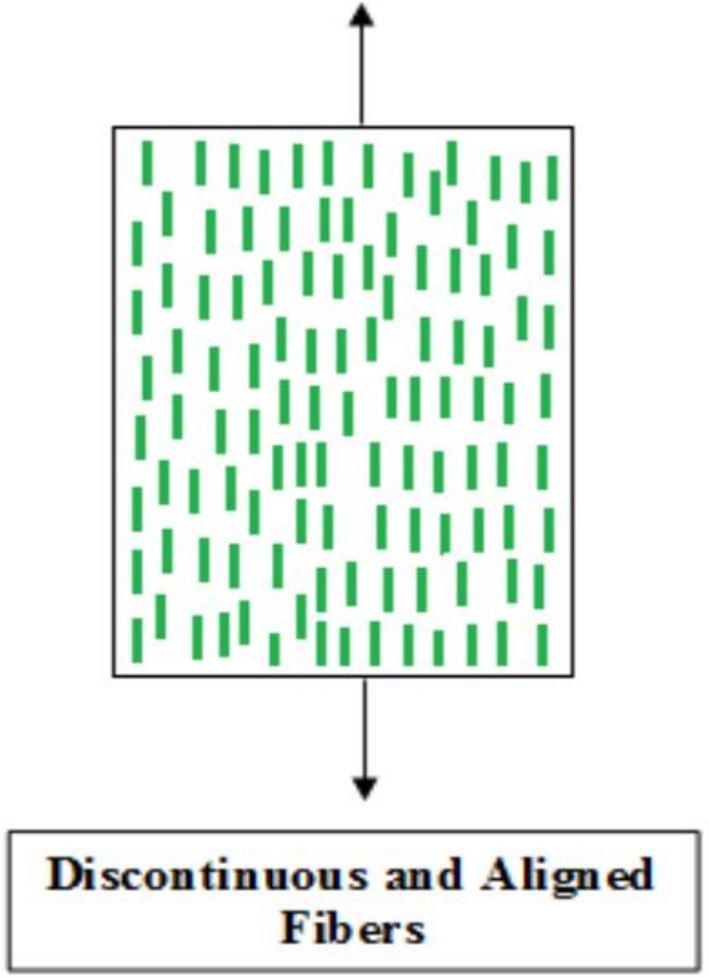
# FIBRE REINFORCED COMPOSITE

What are the constituents constituents in a composite material?

# TYPES OF FIBRE REINFORCED COMPOSITE

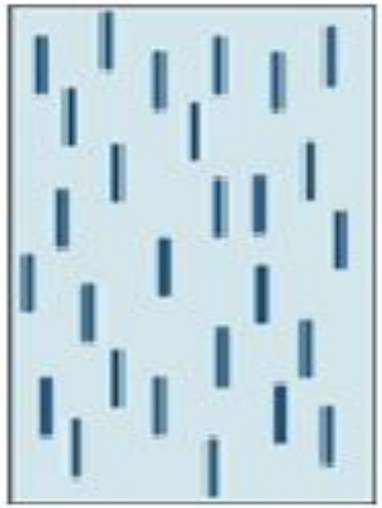


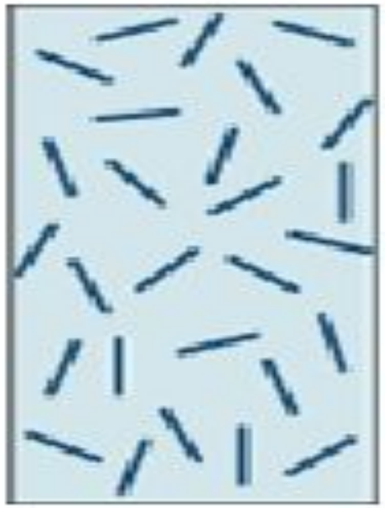
Continuous and Aligned Fibers



Discontinuous and Aligned Fibers

# TYPES OF DISCONTINUOUS FIBRE REINFORCED COMPOSITE





Aligned

Randomly oriented

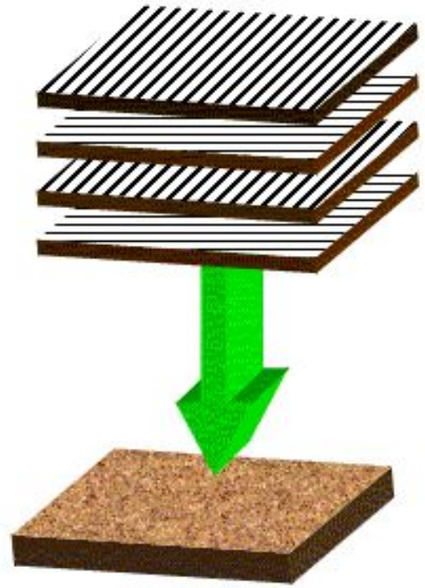
# TYPES OF STRUCTURAL COMPOSITE

## Laminates

**Is composed of two-dimensional sheets or panels that have a preferred high strength direction.**

**Such as is found in wood and continuous and aligned fiber-reinforced plastics.**

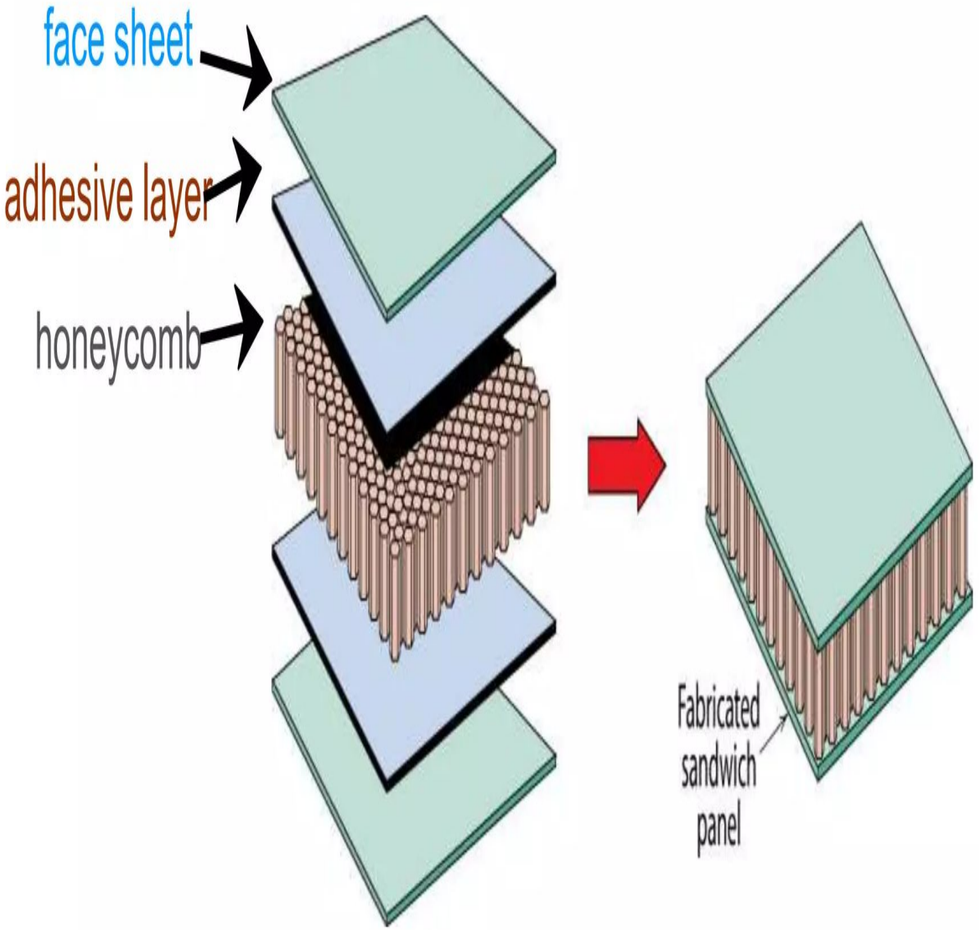
**The layers are stacked and cemented together such that the orientation of the high-strength direction varies with each successive layer.**



# TYPES OF STRUCTURAL COMPOSITE

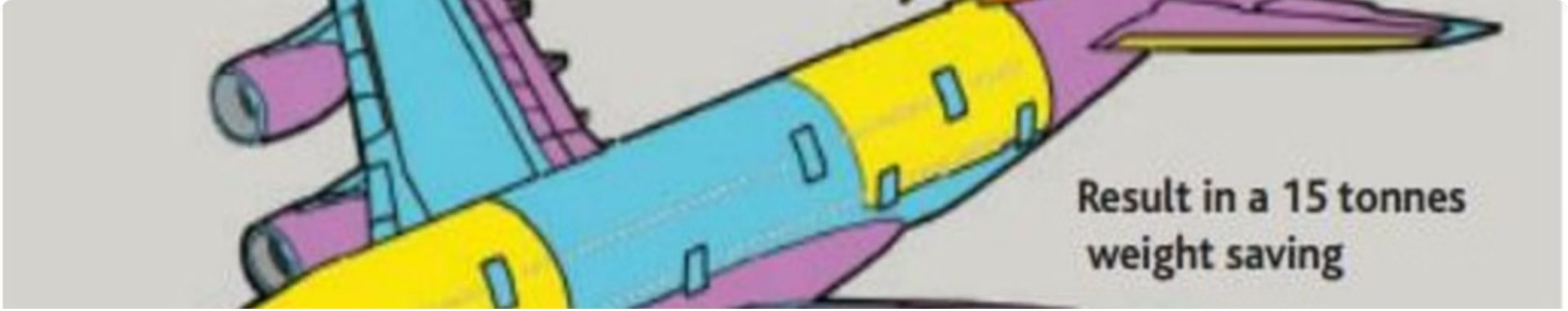
## Sandwich panel

- Consist of 2 strong outer sheets which are called face sheets and may be made of aluminum alloys, fiber reinforced plastics, titanium alloys, steel.
- Face sheets carry most of the loading and stres
- Core may be a honeycomb structure which has less density than the face sheets and resists perp rigidity.



# REFERENCE BOOKS

- Engineering Chemistry, Jain and Jain, Dhanpat Rai Publication
- A textbook of Engineering Chemistry, S. S. Dara, S. Chand and Company




# Conclusion

1 2 3

### Versatility

Composites can be tailored to meet a wide range of design requirements, making them a versatile choice for various applications.

### Advancements

Ongoing research and development in composite materials continue to drive innovation and expand their use in diverse industries.

### Future Potential

As the demand for lightweight, high-performance materials grows, composites are poised to play an increasingly important role in the future.

# QUESTIONS

1.Define composite material.

2. What is the need for composite material?

3. Mention important characteristics of composite material .

4.What is the use of matrix phase in a composite material?

5.Explain the importance of fibre in a composite material.