

4.2 MATERIAL CHARACTERIZATION TESTING

- ❖ Material characterization is the process of measuring and determining physical, chemical, mechanical and microstructural properties of materials.
- ❖ Based on scale of testing, there are two types,
 - Microscopy testing
 - Macroscopic testing
- ❖ Based on testing of composition, there are two types,
 - Spectroscopy & Nuclear spectroscopy

4.2.1 MICROSCOPY

- ❖ Microscopy is a technique that allows the determination of both composition and the structure of a material.
- ❖ It is essentially the process of viewing the structure on a much finer scale not possible with the naked eye
- ❖ The properties of materials with extremely fine features and defects those are only possible to observe using microscopy techniques.

MICROSCOPIC PROPERTIES OF MATERIALS

- Contaminants & Purity
- Ingredients
- Chemical bonding
- Molecular pattern
- Crystal structure & lattice bonding
- Nano Size
- Ions etc.,

COMMON MICROSCOPY INSTRUMENTS INCLUDE

- Optical Microscope
- Scanning Electron Microscope (SEM)

- Transmission Electron Microscope (TEM)
- Field Ion Microscope
- Scanning Tunneling Microscope
- Scanning probe microscopy
- Atomic Force Microscope
- X-ray diffraction topography



4.2.2 SPECTROSCOPY & NUCLEAR SPECTROSCOPY

❖ This group of techniques uses a range of principles to reveal the chemical composition, composition variation, crystal structure and photoelectric properties of materials. Some common instruments include:

- Ultraviolet-visible spectroscopy
- Fourier transform infrared spectroscopy
- Thermoluminescence
- Photoluminescence
- Energy-dispersive X-ray spectroscopy
- Wavelength dispersive X-ray spectroscopy
- Electron energy loss spectroscopy
- X-ray photoelectron spectroscopy
- Auger electron spectroscopy
- X-ray Photon Correlation Spectroscopy

4.2.3 MACROSCOPIC

In which some physical and chemical changes are observed. In this, changes can be observed by the naked eye.

This simple process can yield a large amount of information about the material such as the colour of the material, its luster (does it display a metallic luster), its shape (whether it displays a regular, crystalline form), its composition (is it made up of different phases), its structural features (does it contain porosity) etc.

MACROSCOPIC PROPERTIES OF MATERIALS

- ❖ Density
- ❖ Volume
- ❖ Strength
- ❖ Hardness
- ❖ Roughness etc.,

COMMON MACROSCOPIC INSTRUMENTS INCLUDE

- ❖ Mechanical testing, including tensile, compressive, torsional, creep, fatigue, toughness and hardness testing
- ❖ Differential thermal analysis
- ❖ Dielectric thermal analysis
- ❖ Thermo gravimetric analysis
- ❖ Differential scanning calorimetry
- ❖ Impulse excitation technique
- ❖ Ultrasound techniques, including resonant ultrasound spectroscopy and time domain ultrasonic testing methods

