1. Why ZnO is potential in researches?

**Wide Band gap**

ZnO has a wide bandgap, making it suitable for **optoelectronic applications**, including ultraviolet (UV) light detection and emission.

**Transparent Conductive Properties**

ZnO thin films can exhibit excellent transparency in the visible range combined with good electrical conductivity. This makes them suitable for transparent conductive coatings in applications such as **solar cells** and **touchscreens**.

**Semiconductor Properties**

ZnO is a semiconductor with good electron mobility, making it suitable for electronic and semiconductor device applications.

**Piezoelectricity:**

ZnO is a piezoelectric material, meaning it can generate an electric charge in response to mechanical stress. This property is valuable for sensors and energy harvesting applications.

**Biocompatibility:**

ZnO is generally biocompatible, making it suitable for applications in biomedicine and bioelectronics**.**

**Photocatalytic Activity:**

ZnO exhibits photocatalytic activity, which can be harnessed for applications in water purification, air treatment, and other environmental remediation processes**.**

**Gas Sensing Applications:**

ZnO is sensitive to various gases, making it suitable for gas sensing applications.

**13. Light-Emitting Diodes (LEDs):**

ZnO can be used in the development of LEDs due to its ability to emit light in the UV range.

1. Why wide band gap is good in optoelectronics materials?

**Optical Transparency:**

Materials with a wide bandgap have **higher transparency in the visible region** of the electromagnetic spectrum. This transparency is crucial for applications such as light-emitting diodes (LEDs), solar cells, and optical sensors.

**Higher Photon Energies:**

A wide bandgap corresponds to higher energy photons. This allows for the absorption and emission of photons in the ultraviolet (UV) or shorter-wavelength visible light range, providing versatility in optical applications.

**Reduced Absorption in Visible Range:**

Wide bandgap materials absorb less in the visible spectrum, making them suitable for applications where the absorption of visible light needs to be minimized. This property is valuable for optical coatings and transparent conductive materials.

**UV Detection and Emission:**

Wide bandgap materials are often used in UV detectors and emitters. For example, materials like gallium nitride (GaN) with a wide bandgap are used in UV LEDs and photodetectors.

**Reduced Electrical Leakage:**

Wide bandgap materials generally have lower **intrinsic carrier concentrations**, reducing **electrical leakage** in electronic devices. This is beneficial for the performance of optoelectronic devices such as photodetectors and solar cells.