

3. Results and Discussion

3.1. UV-Vis spectroscopy Measurement

3.1.1 UV-Absorption Spectrum Analysis

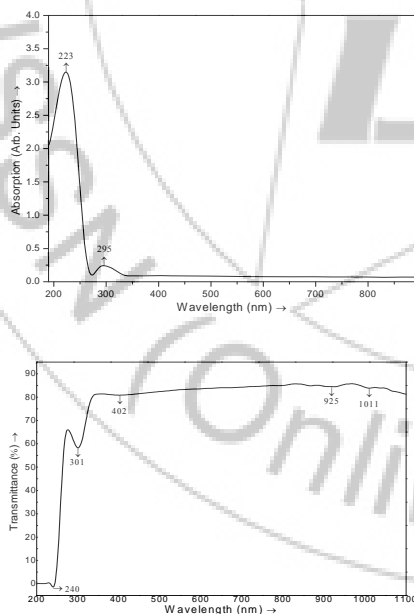


Figure 1: Absorption and Transmission Spectrum of Bismuth Sulfide

The figure 2 Shows the UV-Vis Absorption spectra of Bismuth Sulfide nanoparticles in the region from 200 to 400 nm. In these Absorption spectra there is a peak presented at 200 to 250 nm and 275 to 325 nm but there is a first maximum peak 223 nm. In the second minimum peak 295

nm. Figure 3 Shows the UV-Vis Transmittance spectra of Bismuth Sulfide nanoparticles in the region from 200 to 1100 nm.

In this Transmittance spectra there is a peak presented at 200 to 400 nm and 900 to 1100 nm but there is a first maximum peak 240 nm & 301. In the second minimum peak 925 nm & 1011 nm.

Table 1: Absorption and Transmission Peak of the Sample

Type of the Sample	λ_{max-1} (nm)	λ_{max-2} (nm)	Transmission Peaks in nm
Bi_2S_3	293	295	340 and 925

3.2 FT-IR Spectrum Analysis

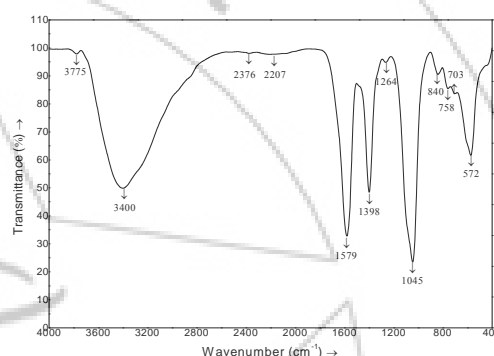


Figure 2: FTIR Spectra of Bismuth Sulfide nano powder

FT-IR spectrum of this compound was recorded in the region 400–4000 cm^{-1} on IFS 66V spectrophotometer using KBr pellet technique is shown in Fig.2. FT-IR spectrum of Bi_2S_3 powder thermally treated at 170–190°C. The response a molecule has to irradiation depends upon the energy. The radiation contains and the pathways of energy dispersal available to the molecule. When a molecule is irradiated, it will absorb the energy. Remember, energy levels are quantized, so you need the right energy to effect an energy level transition. If, for example, the energy absorbed corresponds to an electronic energy level, an electron will be promoted from a bond orbital to an anti-bonding orbital. By examining how molecules interact with electromagnetic radiation of specific energy, we can learn about the structures and properties of the molecules. FT-IR spectrum is used to examine the functional groups are present in the sample.

FT-IR spectra of Bi_2S_3 nanoparticles are shown in figure 4. The IR spectrum of the precursor exhibits absorption peaks. The broad absorption band centered at 3775 cm^{-1} and 3400 cm^{-1} is attributed to the band O-H stretching vibrations, and the band at 1579 cm^{-1} is attributed to bending mode (H–O–H). The band at 1398 cm^{-1} is primarily due to the banding vibration of ionic CO_3^{2-} . The three bands appearing around 1264, 1045 & 572 cm^{-1} confirm the presence of C–O in the precursor. The strong band at 840 & 758 cm^{-1} corresponds to the banding vibration of Bi-S band.

3.3 XRD Diffraction Studies

The obtained samples are characterized on a Rigaku X-ray diffractometer (XRD) with Cu K α radiation (1.540 Å). The XRD pattern of the Final product shows above fig 3.

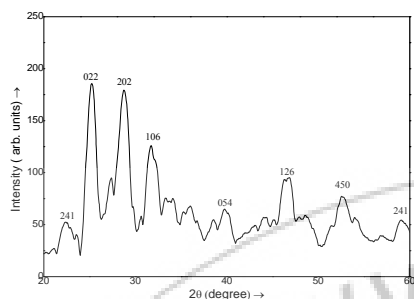


Figure 3: XRD pattern of Bismuth Sulfide nano powder

Powder

Almost all peaks in the pattern could be indexed to orthorhombic Bi₂S₃ with cell constants of $a = 3.981 \text{ \AA}$, $b = 11.140 \text{ \AA}$, $c = 11.305 \text{ \AA}$, which are closed to the reported literature. The diffraction peaks Bi correspond to the (0 7 2), (1 0 4) and (1 4 8) at corresponding 2θ value of 26.6° , 31.3° and 52.6° respectively. On the other peaks sulphur corresponding (7 2 1), (3 4 2), (2 6 1) and (0 4 1) corresponding 2θ value 29.2° , 44.4° , 48.2° and 55.8° respectively. The diffraction peaks were narrow and sharp; indicating that the products were of high degree of crystallinity with their atoms residing in crystalline lattice. The sharpness of all the peaks implies that the sample is crystalline even at room temperature. The purity of the sample is established by the complete absence of impurity peaks. The particle size was calculated using the Scherrer equation,

$$D = \frac{k\lambda}{\beta \cos \theta} \quad (1)$$

Where D is the particle size, K is the Scherrer constant (~ 0.9), λ is the wavelength of X-rays, β is the Full Width Half Maximum and θ is the Bragg angle [18-19]. The average crystallite size was found to be in the range 6-10nm.

3.4 Morphological Analysis

FESEM-EDAX Analysis

The microstructure of obtained Bismuth sulfide were studied by field emission scanning electron microscopy (FESEM Zeiss Ultra Plus) equipped with energy dispersion spectroscopy (FESEM with EDAX with detector Bruker AXS, software: Genesis). Surface and surface related structures, topography and morphology of the specimens are investigated with FE-SEM. The morphology of Bi₂S₃ nano particles including particle size and structure was determined by FE-SEM in the figure 4 shows the sample.

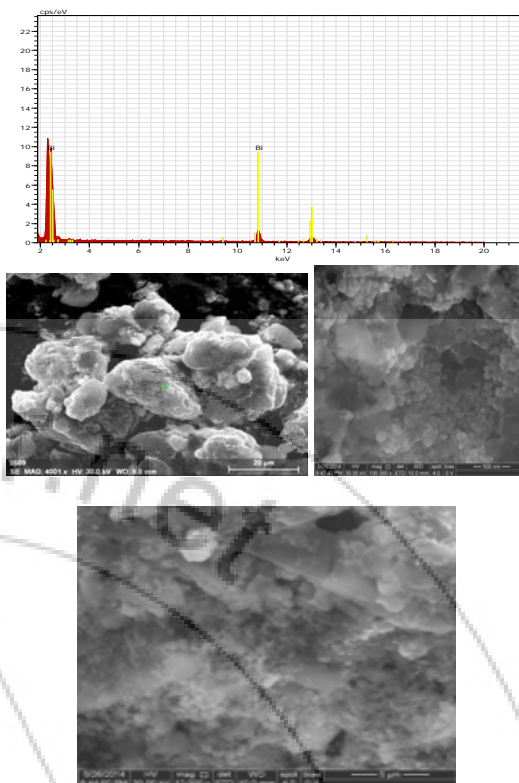


Figure 4: FESEM with EDAX micrograph of Bi₂S₃

4. Conclusion

In the present work, the nano sized Bi₂S₃ particles were successfully generated by direct precipitation method using Bismuth nitrate as bismuth source and sodim thiosulphate as precipitating agent in aqueous solution. In XRD analysis, the size range of the generated Bi₂S₃ powder was approximately 6-10 nm. The FE-SEM analysis shows that the particles morphology was spherical structure of Bi₂S₃ nanoparticles and that they are well crystallized in the nanosize of 30–50micro meter scale. The FT-IR spectrum shows the existence of OH-, CO₂, and CO groups in uncalcined sample. The band gap was lower for synthesized Bi₂S₃ nanoparticles than their bulk counterparts. Thus, the synthesis of Bi₂S₃ nanoparticles by direct precipitation method is simple, fast and eco-friendly in nature.

References

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Author Profile



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