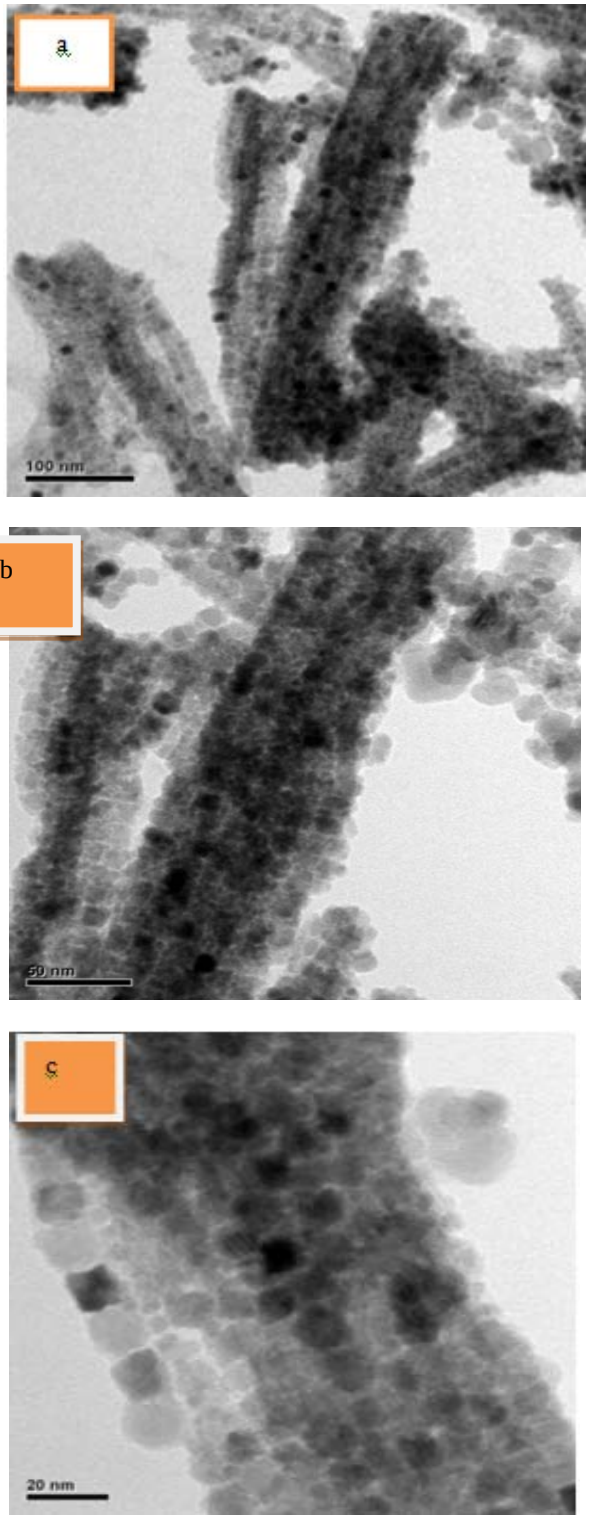
$ZnMn_2O_4$ nanocrystals were polycrystalline in nature. The lattice spacings of 3.8Å, 3.2Å corresponds to the indexed peaks (211) and (200) from the XRD spectrum**.**



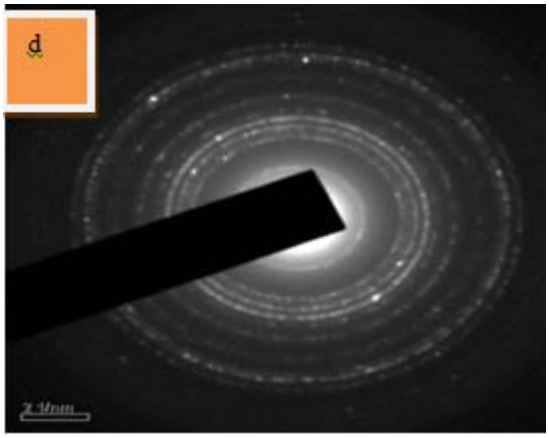


Figure 5: a, b, c) low –magnification ,high-magnification d)SAED of HRTEM image of $ZnMn_2O_4$

3.5 UV-VISIBLE SPECTROSCOPY:

UV-Visible absorption, and band gap spectra for Hetarolite - $ZnMn_2O_4$nanoparticles are shown in Figure .6. The spectrum shows the band edge- absorption peak which is found to be at 233nm. In UV-Vis, high energy electromagnetic radiation in the wavelength range of 100-700nm is utilized to promote electrons to higher energy orbital's. From the UV spectra, it is clear that he absorbance decreases with increase in wavelength. This decrease in the absorption indicates the presence of optical band gap in the material. The relation between absorption coefficients (α) and the incident photon energy (hυ) is given by the equation,

$$\alpha h\upsilon = A\,(h\upsilon - E_g)^n$$

Where A is a constant .E_g is the band gap of the material and the exponent 'n 'depends on the type of transition n=1/2,2.3/2&3 corresponding to allowed direct, allowed indirect respectively talking n=1/2, we have calculated the direct energy band gap from the $(\alpha h\upsilon)^{1/n}$ vs hυ plots(fig).using this method , the estimated band gaps of the sample is found to be 1.54eV

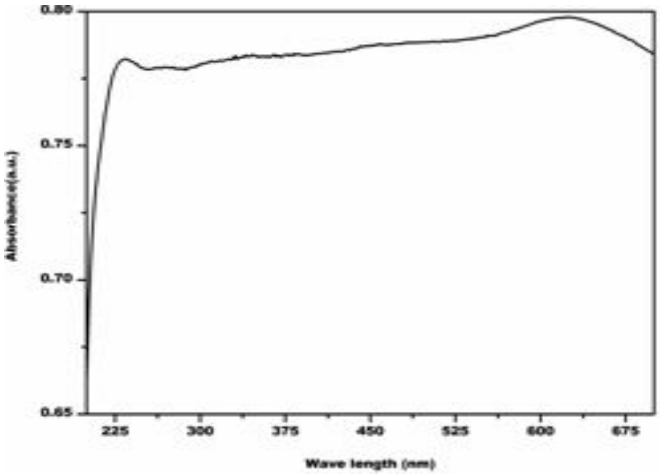


Figure 6: UV-Vis spectrum and $(\alpha h\upsilon)^2$vs hυ graph

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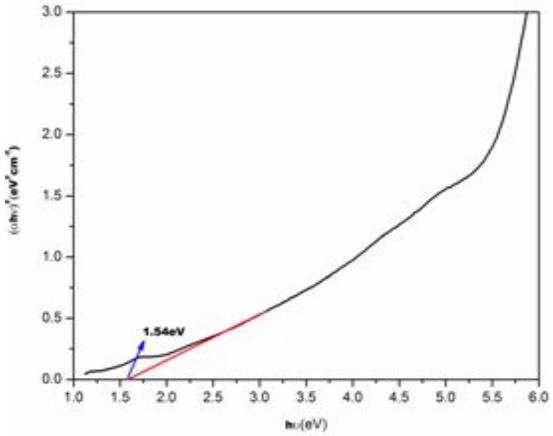

Figure 6: UV-Vis spectrum and $(\alpha h\upsilon)^2$vs hυ graph

4. Conclusion

This study demonstrates the fact that manganese acetate and zinc acetate are a proper precursor for the formation of Hetarolite -$ZnMn_2O_4$ nanoparticles. The XRD pattern confirms that the Hetarolite -$ZnMn_2O_4$is formed in the tetragonal spinel structure. FTIR spectrum reveals that the sample prepared has the finger print of Hetarolite -$ZnMn_2O_4$nanoparticles. The major stretching and bending vibrational frequencies have been identified. Hetarolite -$ZnMn_2O_4$nanoparticles were prepared by hydrothermal method using different magnification and different amount of surfactant. Oleic acid was used as a surfactant in the formation of Hetarolite -$ZnMn_2O_4$. FESEM images confirm the formation of nano-fiber like rod structures. The results of HRTEM and SEAD corroborate very well with that of FESEM and XRD results respectively

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