

# Synthesis of nanocrystalline ZnCeO<sub>2</sub> by sol- Gel method

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**ABSTRACT:** ZnCeO<sub>2</sub> nanoparticles were successfully synthesized by Sol-gel technique. It is simple , rapid and more effective technique for synthesis metal oxide and mixed oxide ZnCeO<sub>2</sub> .Two type of sample synthesized at different temperature 200<sup>o</sup> C and 400<sup>o</sup> C of different thermal annealing sources .The synthesized ZnCeO<sub>2</sub> nanoparticles characterized by scanning electronic microscopy (SEM) and X-ray diffraction method SEM image reveal that spherically shape The of synthesized sample is highly crystalline and size of particles of ZnCeO<sub>2</sub> found to be 14 nm.by XRD analysis

**Keywords :-**Sol –gel process , ZnCeO<sub>2</sub> Nanoparticals ,XRD, SEM.

## 1.Introduction

ZnCeO<sub>2</sub>Mixed oxide is photocatalyst , due to its photocatalytic activity it has wide application.The different chemical methods employed to synthesis of nanocrystalline like sol- gel method[1],[2] ,[3] sonochemically [4]], [5],co-precipitation[6],solvothral technique [7],,microwave synthesis [8],[9] etc. Out of these sol- gel process has many advantages and it is the most practical process in preparation of porous ceramic membrane. By this method synthesis of metal oxide and mixed metal oxide have superior homogeneity and well defined pore size distribution and a better control over the micro structural properties of the nanocrystal [10] .mostly the nanoparticles synthesized by sol gel- process and amorphous in nature and it require further heat treatment process for the production of crystalline particles[ 11] .The sol-gel process is wet chemical technique .Recently the sol-gel technology is widely used in the fields of material science and ceramic engineering .It is an effective technique to synthesis nanoparticles due to its high production rate and rapid productivity of fine homogeneous powder. It has low processing cost high activity,good atomic efficiency and rapid response to changing condition in catalyst system.

The present work focus on the synthesis nanocrystals of ZnCeO<sub>2</sub> by sol-gel process .These nanoparticles are characterized by XRD diffraction and morphology of nanocrystalline were investigated by scanning electron microscopy(SEM)

## 2. EXPERIMENTAL

ZnCeO<sub>2</sub>nanoparticales were synthesised by sol-gel method .All the chemical used in the experiment were analytically grade and were used without further purification. Nanoparticles were synthesised by mixing 100 ml( 0.1M) zinc nitrate Zn(NO<sub>3</sub>)<sub>2</sub>. 6H<sub>2</sub>O 100ml (0.1M)Ammonium ceric nitrate (NH<sub>4</sub>)<sub>2</sub>Ce(NO)<sub>2</sub> by stirring 45 min. followed by added 50 ml(0.1M) citric acid solution dropwise with vigorous stirring .The resulting solution turned to yellowish .The reaction mixture was then heated at about 80<sup>o</sup> C for 2 Hours with continuously magnetic stirring until the gel was formed. The gel was dried in oven at 100<sup>o</sup> C for 2 Hrs. which leads the formation of light weight porous materials due to the evolution of gas. It was sintered at 200<sup>o</sup>C for 3 hrs in oven and another sample annealed at about 400<sup>o</sup>C fo 2 hrs in mufale furnace to get fine homogeneous dense powder.Crystals of ZnCeO<sub>2</sub> .Powderwas washed with de-ionised water for several times to remove unreacted impurities. Synthesised powder characterized by SEM and XRD.

## 3.RESULT AND DICUSSION

**3.1 XRD Patterns of the Samples**The x-ray diffraction of synthesized ZnCeO<sub>2</sub> oxide studied using cu radiation(1.5406A0).The synthesized nanoparticles were pure .All the diffraction peak are rather sharpe which indicate the ZnCeO<sub>2</sub> sample has high degree of crystallinity.The characteristic peak are observed at 2 $\theta$  values at 28.2. From XRD data crystalline size synthesized ZnCeO<sub>2</sub> particles was estimated by De-bye scherrers equation  $D_p=0.9\lambda/\beta\cos\theta$  where  $D_p$  is the size of particle in nm , $\lambda$  is wavelength of x-ray (1.5406) and  $\beta$  is the full width at half maximum (FWHM) and  $\theta$  is the diffraction peak angle.XRD pattern of synthesied ZnCeO<sub>2</sub>is structural properties.The average partical size of nanocrystals calculated with XRD and it is found 14 nm.

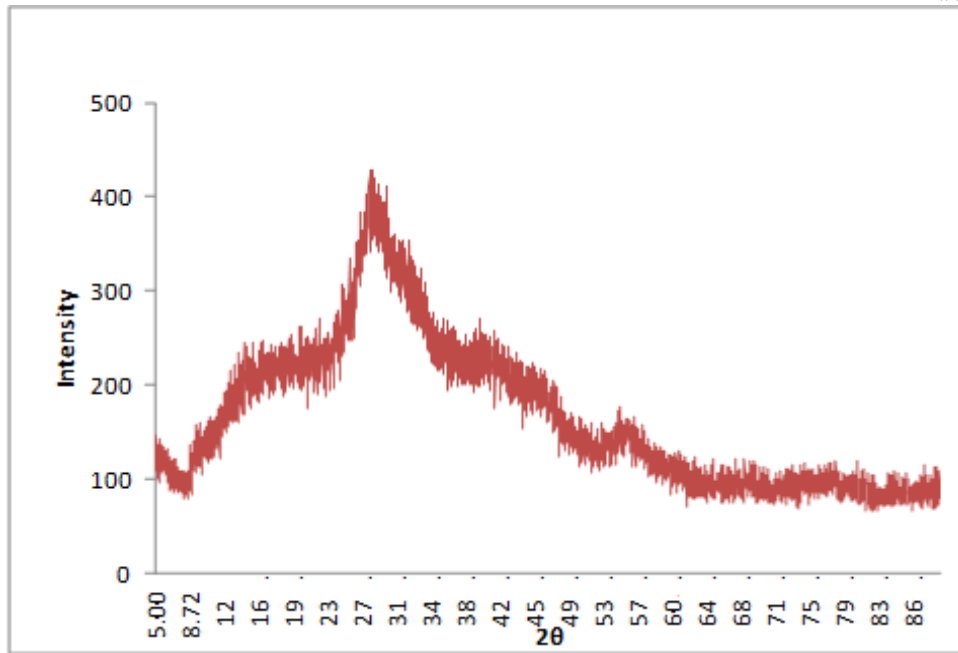


Figure (a) XRD of nanocrystalline ZnCeO<sub>2</sub>

### 3.2 SEM image of ZnCeO<sub>2</sub>

SEM analysis of Synthesized ZnCeO<sub>2</sub> shown that completely different surface morphology behavior due to effect of different heat treatment. SEM image reveals **nanoparticles is spherical shaped**.

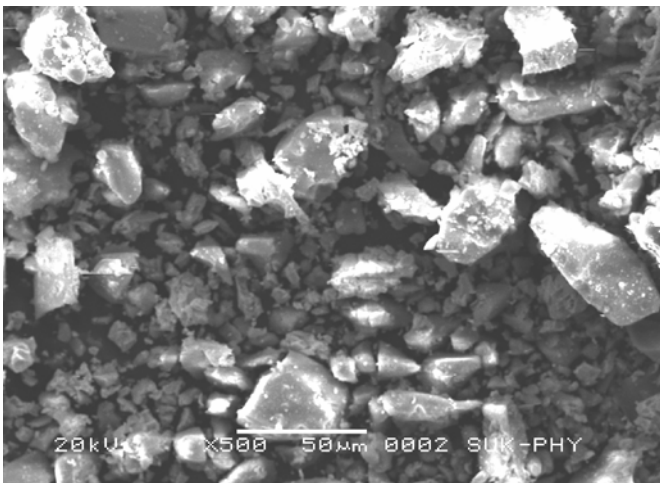


Fig. (b)

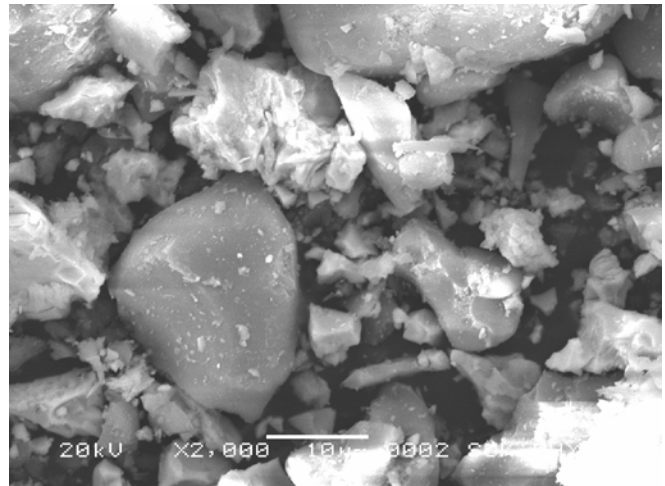
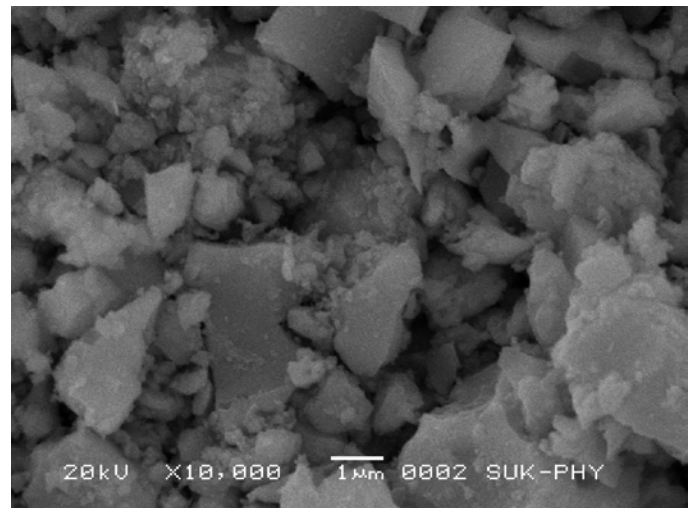
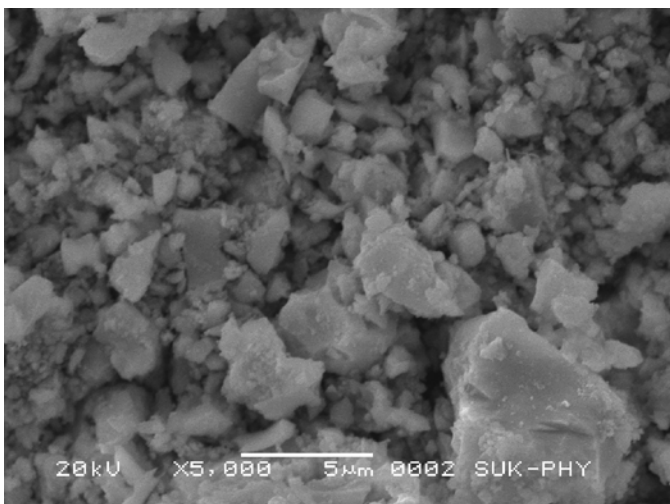


Fig.(c)

Fig. (b) and (c) SEM image of ZnCeO<sub>2</sub> sample annealed at 200°C.



(e)  
(d)

Fig. (d) and (e) SEM image of  $ZnCeO_2$  sample annealed at  $400^\circ C$

## 5. CONCLUSION

Sol-gel method to synthesis  $ZnCeO_2$  has been successfully established. This method is effective to control morphological and structural properties. The average partical size of nanocrystals calculated with XRD and it is found 14 nm. The SEM image of synthesized mixed oxide  $ZnCeO_2$  shows different morphological behaviour at different annealing temperature  $200^\circ C$

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