Synthesis of Sol-gel derived ZnO nanopowder for Photovoltaic applications

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Abstract

In the present work, ZnO nanoparticles are synthesised by using Sol-gel technique. The morphological (TEM and XRD) and optical studies (FTIR) of the grown ZnO nanparticles are made. The average particle size of the grown ZnO nanoparticles are made. The average particle size of the grown ZnO nanoparticles is about 40nm which is suitable to be used as transparent conducting oxide layer in dye sensitised solar cells (DSSC).

1. Introduction

ZnO is considered as a good candidate for transparent conducting electrodes in solar cells because it is transparent to the visible light. It is also considered as a prime candidate for light-emitting devices such as blue LED and Lasers due to its large exciton binding energy. Due to such large exciton binding energy, the excitons remain dominant in optical processes even at room temperature. Due to its vast industrial applications such as electrophotography, electroluminescence phosphorus, pigment in paints, flux in ceramic glazes, filler for rubber products, coatings for paper, sunscreens, medicines and cosmetics, ZnO is attracting considerable attention in powder as well as thin film form.[1-3] Its resistance to radiation damages also makes it useful for space applications. It is also used as transparent conducting oxide layer in Dye Sensitized Solar Cells (DSSCs). DSSCs are among the most promising candidates for alternative renewable energy devices, having the advantages of low cost and large scale processing [4-12]. In the present work, ZnO nanoparticles are grown by cost-effective technique i.e. sol-gel.

2. Experimental

All the reagents used were of analytical grade. ZnO nanopowder was prepared by dissolving 0.2M Zinc acetate dihydrate $[Zn(CH_3COO)_2.2H_2O]$ in methanol at room temperature and then mixing this solution ultrasonically at $25\ ^0C$ for 2h. Clear and transparent sol with no precipitate and turbidity was obtained. 0.02 M of NaOH was then added in the sol and stirred ultrasonically for 60 min. The sol was kept undisturbed till white precipitates were seen in the sol. After precipitation, the precipitates were filtered and washed with the excess methanol to remove starting material. Precipitates were than dried at 80^0C for 15 min on hot plate.

3. Results and Discussion

TEM image of the sol-gel derived nanoparticles are shown in Fig. 1. It can be seen from the TEM image that the average particle size is ~ 40 nm.

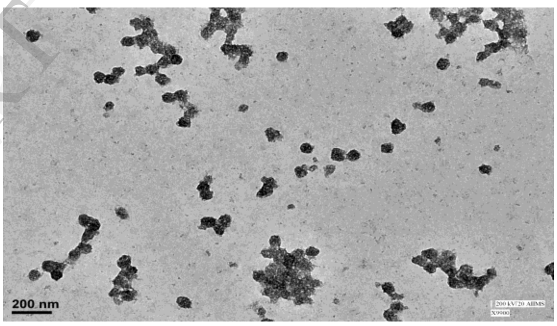

Fig. 1 TEM image of the sol-gel derived ZnO nanoparticles

The XRD pattern of the grown nanoparticles is shown in Fig. 2 and it shows crystalline nature with peaks lying at 31.750^0 <100>, 34.440^0 <002>, 36.252^0 <101>, 47.543^0 <102>, 56.555^0 <110>, 62.870^0 <103>, 66.388^0 <200>, 67.917^0 <112>, 69.057^0 <201>, 72.610^0 <004>, 76.95^0 <202>, 81.405^0 <104>, and 89.630^0 <203>. These peak positions coincide with JCPDS card no. 36-1451 for ZnO powder.

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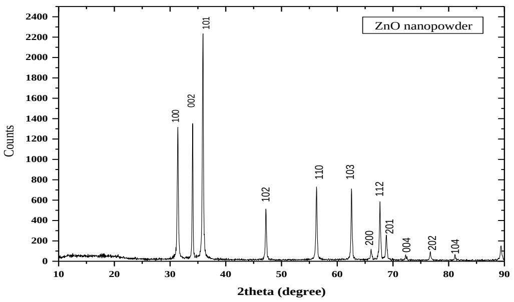
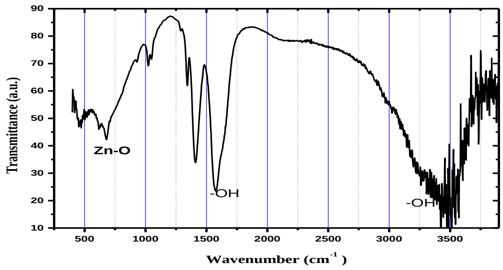


Fig. 2 – XRD pattern of ZnO nanoparticles synthesized via sol-gel



route

Fig. 3 FTIR spectra of sol-gel derived ZnO nanoparticles

FTIR spectra of the grown ZnO nanoparticles is shown in Fig.3. The valley at 700 nm shows the Zn-O bond. It confirms the successful growth of ZnO nanoparticles.

4. Conclusion

ZnO nanoparticles are grown by sol-gel technique. The grown material is highly crystalline in nature and has average particle size ~40 nm. It is a potential material to be used as transparent conducting oxide layer to be used in DSSC.All manuscripts must be in English. These guidelines include complete descriptions of the fonts, spacing, and related information for producing your proceedings manuscripts.

5. References

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