Synthesis and characterization of doped ZnO nano-material for removing hazardous impurity of Arsenic in water

Summary of Dissertation

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Submitted By

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Summary

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The summary of the M.Phil. dissertation work has been organized in the chapter wise. In the *Chapter-1*, we have started with the introduction of the water problems throughout the world. All the water contaminants are listed with their impact on our human life. The arsenic impurity in the water, which is found in most states of India especially Uttar Pradesh, Bihar and West Bengal, is very hazardous for human life. This chapter also contains the literature survey on the the synthesis of metal oxide nanomaterials (especially ZnO & Cu:ZnO nanomaterials) by low cost and simple method like co-precipitation method and the literature survey showed that the ZnO & Cu:ZnO nanomaterials are fruitful to remove the arsenic impurity from earth's water.

In the *Chapter-2*, we have discussed the various methods of synthesis to synthesize the metal oxide nanomaterials. Among the various methods for synthesis of the nanomaterials, the Co-precipitation method is the best, very simple process and low cost method which can be done at room temperature and ambient pressure. The characterization techniques are also described in this chapter. These characterization techniques are used to analysis the properties of synthesized nanomaterials for the nano-catalytic system. We have discussed characterization techniques of SEM/FESEM, EDX, XRD, UV-visible spectrometer for analysing the elemental composition, morphology, structure information, shape, size as well as chemical and physical property of the synthesis metal oxide nanomaterials and such analysis of the synthesis nanomaterials is useful and important to support for removable of the hazardous water contaminants.

The *Chapter-3* is reported the results and discussion of the synthesis and characterization of the ZnO nanomaterials and copper doped ZnO (Cu:ZnO) nanomaterials. It contains *two parts*: first part gives the synthesis and characterization of pure ZnO nanomaterials where three samples (A, B and C) are prepared at different

annealing temperatures. These A, B and C samples of pure ZnO nanomaterials are analyzed the elemental composition, morphology, structure information, shape, size of the synthesis pure ZnO nanomaterials; second part gives the synthesis and characterization of the Cu(1%):ZnO nanomaterials and Cu(2%):ZnO nanomaterials. The pure ZnO nanomaterials, Cu(1%):ZnO nanomaterials and Cu(2%):ZnO nanomaterials were synthesized successfully by co-precipitation method. The synthesized pure ZnO nanomaterials, Cu(1%):ZnO nanomaterials and Cu(2%):ZnO nanomaterials were characterized by SEM/FESEM, EDX, XRD, UV-visible spectrometer. Generally the SEM/FESEM is used to analysis the surface morphology. The EDX characterization is used to analysis the elemental composition of the nanomaterials. The XRD characterization is used to analysis the crystalline structure and particle size. The UV-Visible spectrometer is used to calculate the optical band gap. The XRD of the Cu(2%):ZnO nanomaterials was conformed the existance of the copper metal in the ZnO nanomaterials as shown in figure 1.

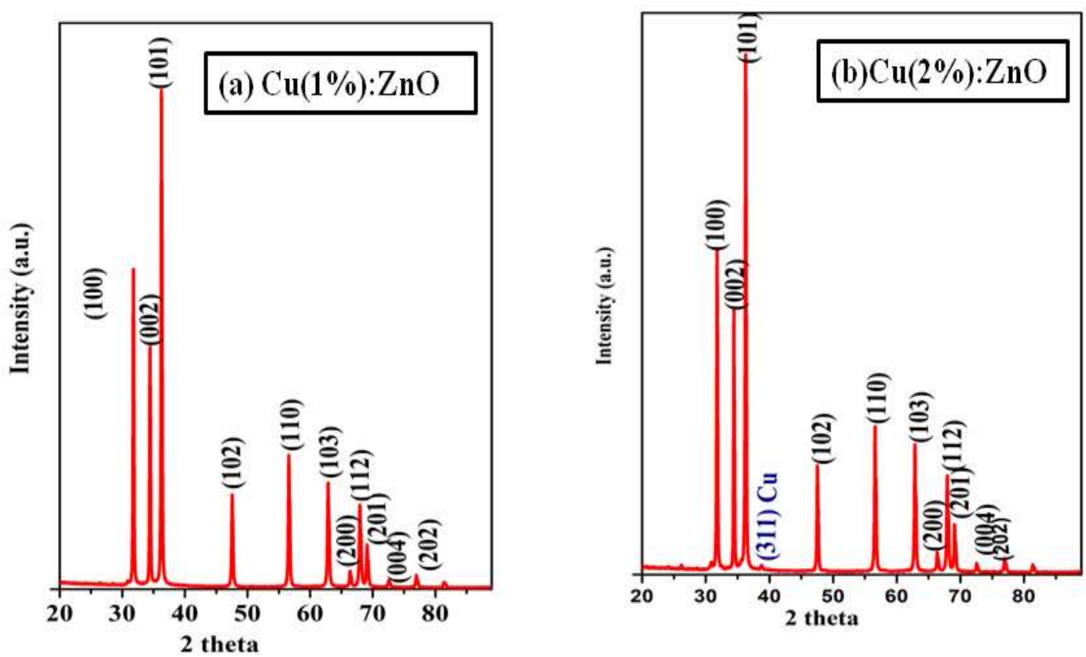


Figure 1: XRD patterns of (a) Cu(1%):ZnO nanomaterials and (b) Cu(2%):ZnO nanomaterials

The surface morphology of the pure ZnO nanomaterials, Cu(1%):ZnO nanomaterials and Cu(2%):ZnO nanomaterials were analysed by the SEM/FESEM as shown in figure 2 and compared them. It has been observed that the Cu(2%):ZnO nanomaterials was found tripod morphology Similarly, the EDX characterizations were also compared where the elemental composition of Cu(2%):ZnO nanomaterials was found to be existance the Zn, Cu and O elements as shown in figure 3.

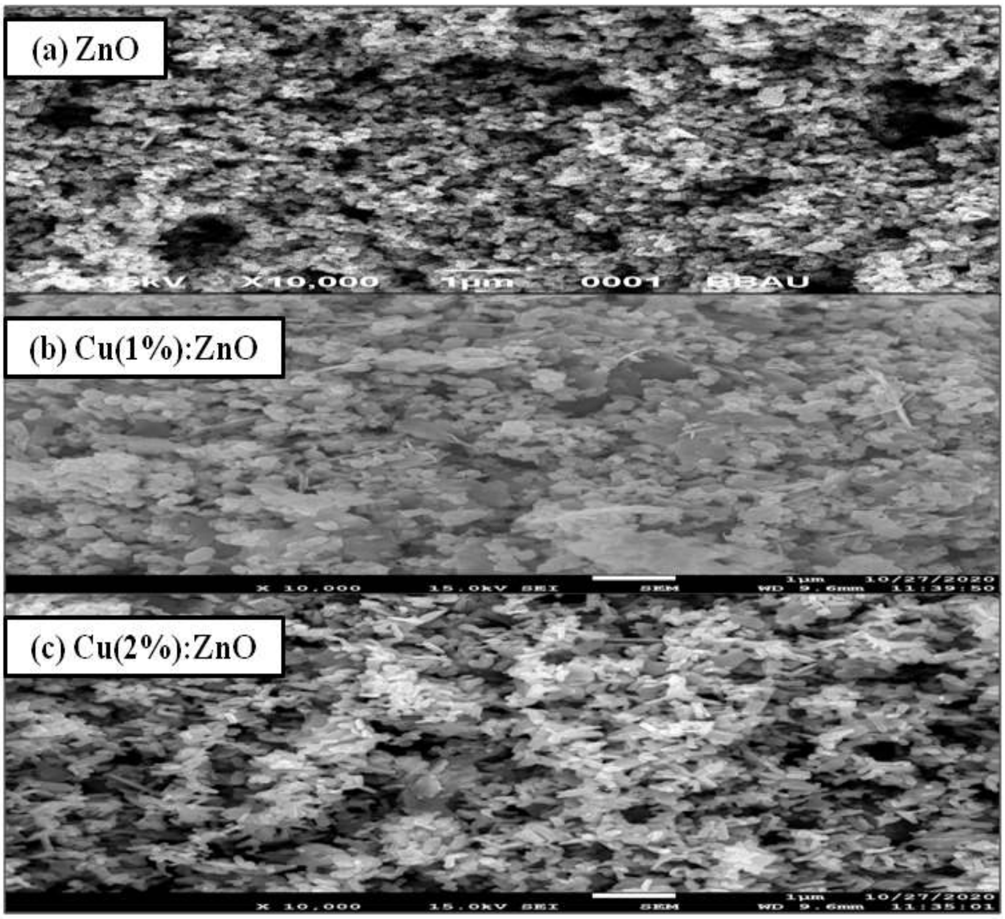
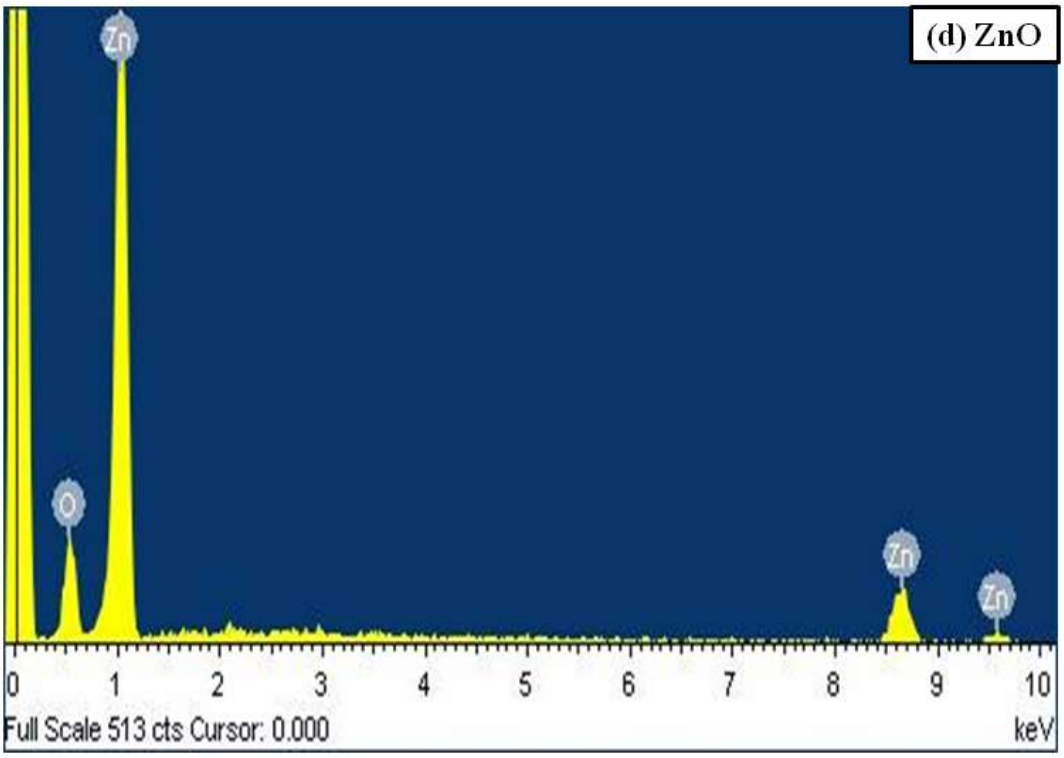
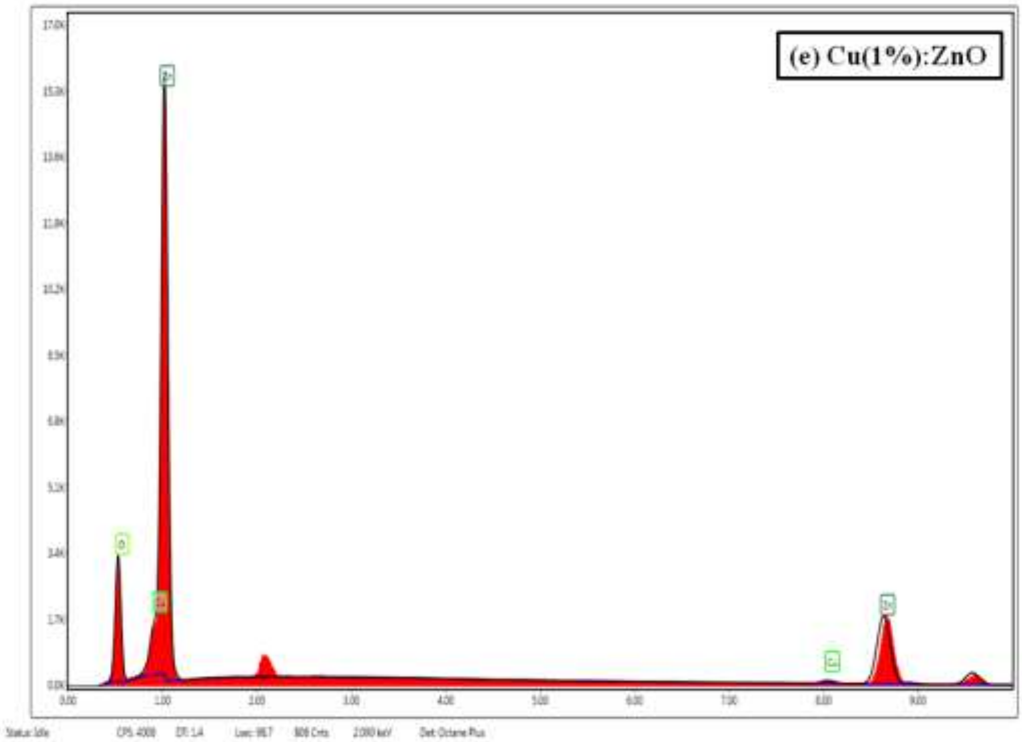


Figure 2: SEM/FESEM images (a) pure ZnO, (b) Cu(1%):ZnO, (c) Cu(2%):ZnO nanomaterials.


(d) ZnO
Zn
O
Zn
Zn
0
1
2
3
4
5
6
7
8
9
10
Full Scale 513 cts Cursor: 0.000
keV


(e) Cu(1%):ZnO
Status: Idle
Det: Octane Plus

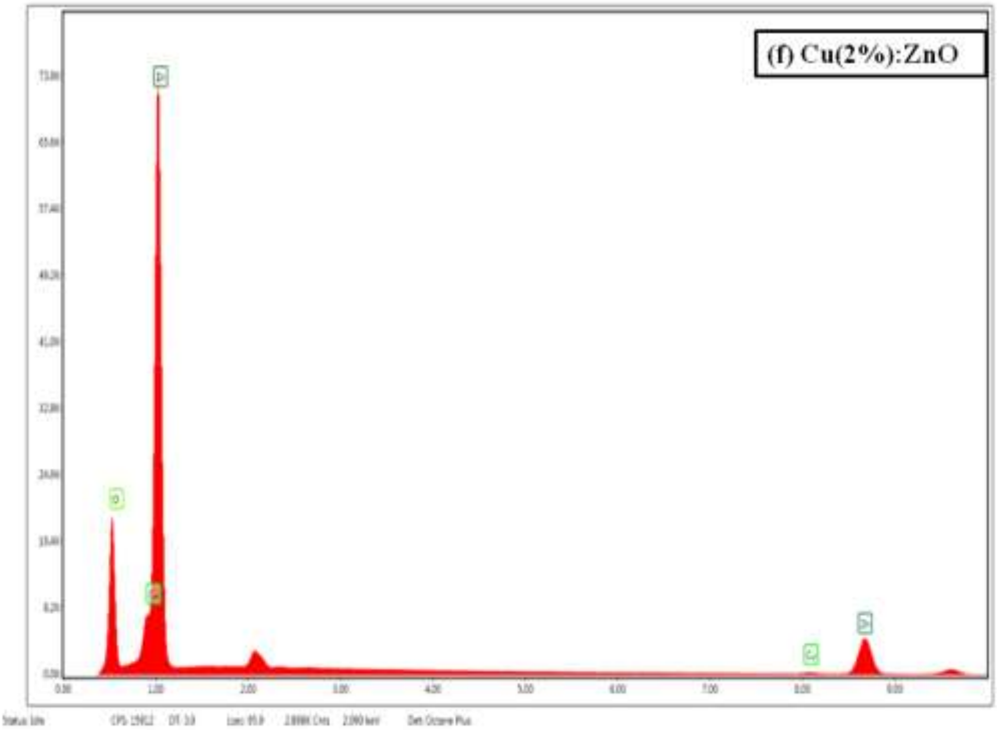


Figure 3 : EDX images of (d) pure ZnO nanomaterials, (e) Cu(1%):ZnO nanomaterials, (f) Cu(2%):ZnO nanomaterials.

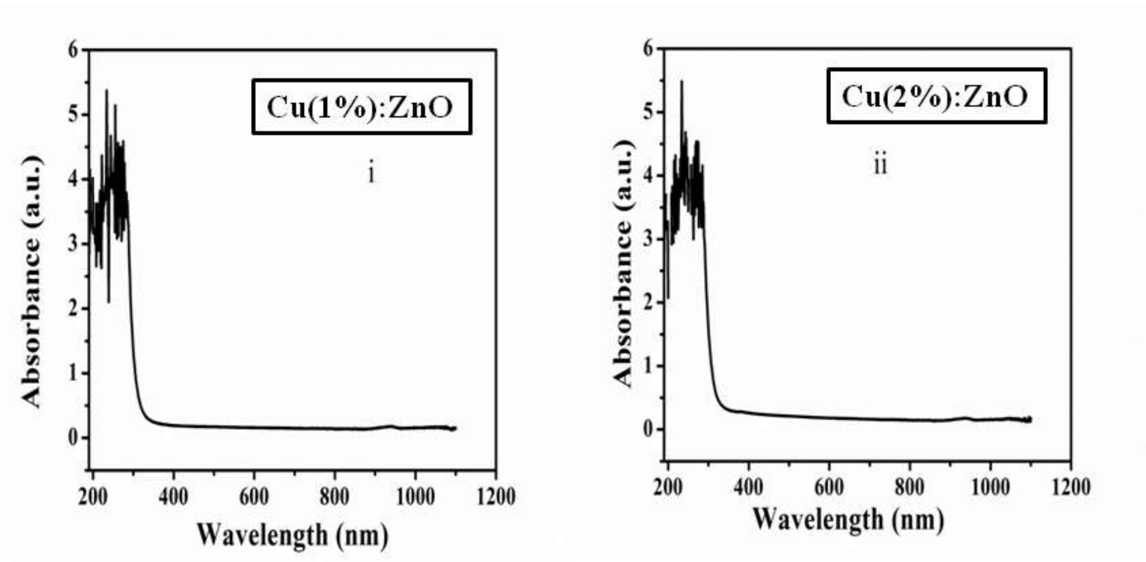


Figure 4: Optical absorption spectra of (i) Cu(1%):ZnO and (ii) Cu(2%):ZnO nanomaterials

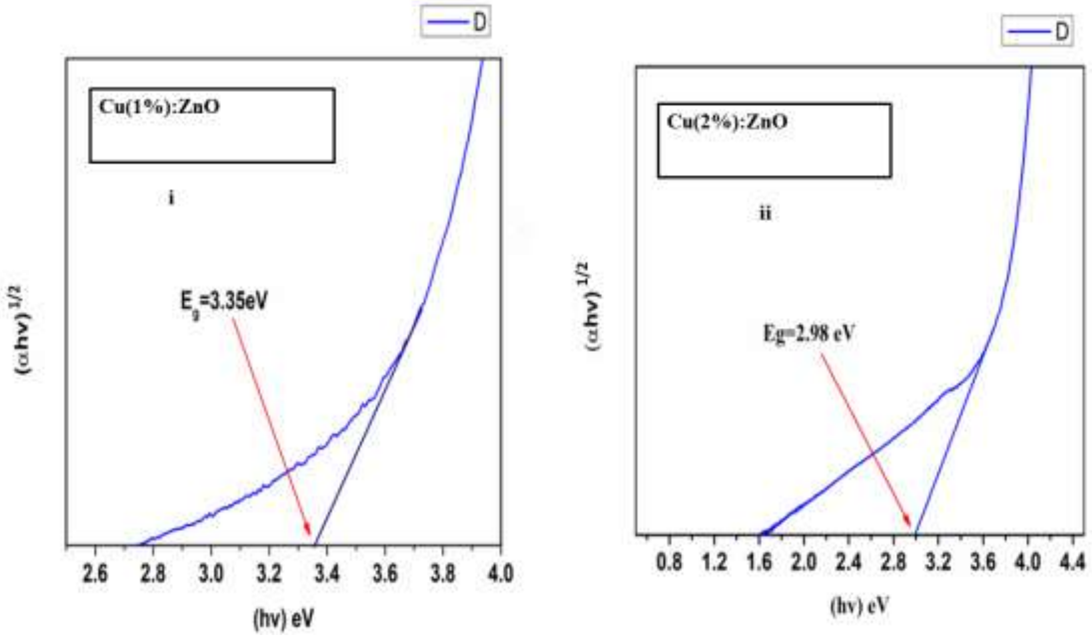


Figure 5: The $(\alpha h\nu)^{1/2}$ versus hν curves for the optical band gap determination of (i) Cu(1%):ZnO nanomaterials and (ii) Cu(2%):ZnO nanomaterial

The absorption spectra of the Cu(1%):ZnO nanomaterials and Cu(2%):ZnO nanomaterials were studied by the UV-Visible spectroscopy as shown in figure.4 and observed results have found the strong band edge visible around 370 nm. This absorption spectra of the Cu(1%):ZnO nanomaterials and Cu(2%):ZnO nanomaterials were used to study the optical band-gaps. The optical band gaps are found to be 3.35eV and 2.98eV for the Cu (1%): ZnO and Cu (2%):ZnO nanomaterials respectively. On the basis of elemental composition, morphology, structure, shape, size as well as energy band gap properties of the synthesized 2% copper doped ZnO nanomaterials is proposed for the removable of the hazardous water contaminants.

The general conclusion and future scope are given in the *Chapter-4* where the pure ZnO nanomaterials, Cu(1%):ZnO nanomaterials and Cu(2%):ZnO nanomaterials was synthesized by low cost co-precipitation method; and the elemental composition, morphology, structure, shape, size as well as energy band gap properties were analyzed by SEM/FESEM, EDX, XRD, UV-visible spectrometer. The Cu(2%):ZnO nanomaterials may be fruitful for nano-catalysis system and such nano-catalysis based on the copper doped ZnO nanomaterials having the good photocatalytic activity may be counterpart of the existing techniques for the removal of trace pollutants/impurities. The further research in future has also given in this chapter that the Pyrex cylindrical batch reactor equipment of the Cu(2%):ZnO nanomaterials may be fabricated for removing hazardous impurity of Arsenic in water, which may be fruitful in treatment or purification of water.