Preparation of Zinc Oxide Nanoparticles by Combustion Method and effect of Photocatalytic Activity

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Abstract: The synthesis of (ZnO) zinc oxide nanoparticles using combustion method. The present study we prepared ZnO nanoparticles from zinc acetate and sodium bicarbonate. The characterization and confirmation of synthesized ZnO nanoparticles performed by UV Visible spectrophotometer. The method synthesis of ZnO nanoparticles are safe and good attractive to the physical and chemical method.

Index Terms: Zinc acetate, Sodium bicarbonate, Zinc oxide nanoparticles.

I. INTRODUCTION

The world have major problem and environmental damage due to the increasing Industry sectors. These industry have more industrial waste causes many harmful disease on human as well as animals. Most of the industrial effluents causes toxic effect on aquatic life. Most of the dyes are carcinogenic like naphthaline, benzidine and many other aromatic compounds (1-3). To remove these organic pollutants and waste, recently researchers develop semiconducting photocatalyst. These semiconducting photocatalyst degrade organic pollutants as well as industrial waste water. The prepared catalyst is most important, green and convert toxic chemical to nontoxic. The catalyst have no any harmful effect to environment (4). Several metal oxides like ZnO, TiO2, CuO, NiO etc. have been utilized as a photocatalyst to remove the organic pollutant.

Among the several metal oxides, ZnO is emerged as promising photocatalyst with its wide band gap (3.37ev). They having large binding energy (60mev), photosensitivity and having thermal stability. In few cases ZnO have exhibited more effective catalyst than that of TiO2 (5-6).

The poor utilized solar energy and the rapid recombination photogenerated electron hole pairs takes place. To remove these limitation increase the particle size, morphology, Surface area as well as deposition of noble metal. For avoid recombination of photogenerated charge, the deposition of noble metal on surface of semiconducting material (8-10). The leading to improve photocatalytic activity noble metal acts as scavenging agent.

In the present study reported for synthesis of ZnO nanostructures by Sol-gel method, Chemical vapor deposition method, hydrothermal, Combustion method, direct precipitation etc.

Materials have two principal approaches for the synthesis of nanomaterials called the “top-down” approach and the “bottom-up” approach. The varieties of techniques that can be classified in top-down or bottom-up approaches are schematically illustrated in Figure

![Diagram](image)

However many methods to synthesize expensive substrates, high temperature calcinations, complex procedures and experienced condition. Out of these synthetic method thermal decomposition method is relatively simple, one step best route to synthesize large scale nanostructures (11-14).

Electrons in the conduction band can be rapidly trapped by molecular oxygen adsorbed on the ZnO particle, which is reduced to form superoxide radical anion (O2−) that may further react with H+ to generate hydro peroxyl radical (•OOH) and further electrochemical reduction yields H2O2.
II. EXPERIMENTAL DETAILS

2.1 Materials and Methods

Zinc acetate dihydrate (Zn(Ac)2·2H2O) and sodium bicarbonate (NaHCO3) were obtained from SD Fine-Chemical Ltd. AgNO3 and MO were purchased from Sigma Aldrich chemicals Pvt. Ltd., Mumbai. All other reagents were of analytical grade and used without further purification.

2.2 Synthesis of ZnO nanorods

ZnO nanorods are synthesized by grinding 2.0 g of Zn(Ac)2·2H2O and 2.0 g of NaHCO3 in a mortar and pestle for 1.5 h, finally this powder was calcinated in silica crucible at 450° C for 3 h under an air atmosphere in a temperature controlled muffle furnace and then allowed to cool. The precursors (Zn(Ac)2·2H2O:NaHCO3) with weight ratio 1:1 and the obtained sample denoted as ZN1. Pure ZnO was also prepared by grinding 2.0 g of Zn(Ac)2·2H2O for 1.5 h without addition of NaHCO3 and then calcined the same conditions and obtained sample was denoted as ZN2. The calcined powders were pulverized into fine particles by using agate mortar and used for the further characterization of the material.

2.3 Characterization of ZnO nanoparticles through UV Visible spectral analysis

The reaction mixture contains ZnO nanoparticles confirmed by using UV Visible absorption spectroscopy analysis (Systronics double beam spectrophotometer model 2202 ) between 250-800nm. All the process was carried out in laboratory at room temperature.

2.4 Photocatalytic Activity

Given 100mg of catalyst and take 20pmm methyl orange solution in a reactor use xenon lamp after 30min. check color changes after 2hours complete degradation takes place and then checking UV by UV Visible spectrophotometer.

III. RESULT AND DISCUSSION

The aqueous solution of seed extract was utilized in the reduction of metal particles and synthesis of zinc oxide nanoparticles. This is successful determination biological active compound from the seed extract depends upon type of solvent used in extraction procedure.
3.1 X-ray Diffraction Analysis

The XRD patterns of ZnO nanorods, the diffraction pattern shows peaks and these indexed for the planes of ZnO hexagonal wurtzite (100), (002), (101), (102), (110), (103), (200), (112), (201), (004), (202) respectively. We also found that, higher proportion of NaHCO3 used for the synthesis of ZN11, ZN21 and ZN31, from this diffraction peaks of Na2CO3 were appeared in the XRD pattern. This due to the NaHCO3 decomposed into Na2CO3 at 500 °C [43]. The crystallite size was calculated by using well known Scherrer’s equation.

Effect of weight ratio of Zinc acetate & NaHCO3 on crystallite size

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>ZnO samples</th>
<th>Weight Ratio of Zinc acetate &amp; NaHCO3</th>
<th>Average crystallite size in nm</th>
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<tbody>
<tr>
<td>1</td>
<td>ZN10</td>
<td>1:0</td>
<td>22</td>
</tr>
<tr>
<td>2</td>
<td>ZN11</td>
<td>1:1</td>
<td>19</td>
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<td>3</td>
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<td>1:2</td>
<td>19</td>
</tr>
<tr>
<td>4</td>
<td>ZN13</td>
<td>1:3</td>
<td>20</td>
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REFERENCES