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Photo Catalytic Oxidation of Benzyl Alcohol to Benzyl Aldehyde using Synthesized Zinc Oxide and Zinc Doped Titanium Oxide

Abutu Isaac Ogbeh*

Department of Chemical Sciences, Federal University Wukari, Taraba State, Nigeria

Abstract

Photo catalytic oxidation of alcohols to carbonyl compounds amongst various organic transformations is important due to its signiýcant role in the synthesis of a variety of ýne chemicals, confectionaries, fragrances, and pharmaceuticals. This Study explores the Comparative Photo catalytic activity of synthesized Zinc oxide and Zinc doped Titanium oxide, for the photo catalytic oxidation of aromatic alcohol to aldehyde. Un-doped and doped zinc oxide (Zn-doped TiO_2 photo catalyst) were prepared using hydrothermal method. The photo catalytic performance of the synthesized photo catalyst was evaluated for the conL ᵀ я conL c ! i to ’ i Selectivity of the product compared to the nw ᴀ " ƙ l d ή i

K of alcohols into carbonyl compounds is highly selective oxidation reaction, which is important from the viewpoint of green and sustainable chemistry. e Visible r

Photocatalysis, Hydrothermal, Benzyl alcohol, Benzyl

conditions. Several Reports has employed several matrices inclusive of ZnO, TiO

$_2$ as photo catalyst due to its high chemical stability, low toxicity, and low cost [7,8].

is research works deals with selective oxidation reaction, which is important from the viewpoint of green and sustainable chemistry in controlling the release of toxic waste. Photo catalytic oxidation as one of the advanced oxidation processes (AOPs) due to strong decomposition characteristic of hydroxyl radicals in removal of organic pollutant has attracted much attention [9]. In view of this, the electron gap generation by the catalyst helps in the oxidation of organic reaction, thereby causing conversion. Various catalysts can be used in photo catalytic process. e primary aim of this study is to examine the potential of synthesized zinc oxide and Zinc doped Titanium oxide as a photo catalyst for converting benzyl alcohol into benzyl aldehyde.

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1.3g Zinc Acetate was dissolved in 50 mL distilled water. Separately, 1g of NaOH was dissolved in 50 mL Ethanol. A magnetic Stirrer was used to yield homogeneity of the solution. en, $NaOH_{(aq)}$ was added drop wise to the Zinc Acetate Solution and allowed to stir for 1hr. e nal mixture was transferred to an autoclave and placed in an Oven at 95^{o}C for 2hrs. e mixture was then ltered and rinsed with distilled water, then placed in an oven to dry at 60^{o}C. e obtained powder was then annealed at 400^{o}C to improve the crystal structure. e whole process was repeated as required using 0.65g of Zinc Acetate which

***Corresponding author:** Abutu Isaac Ogbeh, Department of Chemical Sciences, Federal University Wukari, Taraba State, Nigeria, E-mail: abutuisaac19@gmail.com

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was weighed into a 250mL beaker. e Powder was then characterized using XRD.

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Hydrothermally Synthesized Zinc Oxide was mixed with Commercial TiO_2 powder at 0.1 – 1% of ZnO. A magnetic Stirrer was used to yield homogeneity of the solution. en, $NaOH_{(aq)}$ was added drop wise to the Solution and allowed to stir for 1hr. e nal mixture was transferred to an autoclave and placed in an Oven at 95^{o}C for 2hrs.

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1g of the Synthesized catalyst (ZnO/TiO_2) was placed in a 50mL Conical Flask containing 100mL of Distilled water as solvent and 20micro Liter of Benzyl alcohol and placed in the UV Chamber, for 5 mins, 10 mins, 15 mins, 20 mins, 25 mins and 30 mins. At each run, the process was repeated using 0.5g, 1g, 1.5g and 2g of the photo catalyst. e Result of each process per time was transferred in a clean amber reagent bottle for GC-FID analysis of the resulting product.

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0.051g of the Synthesized catalyst (ZnO) was placed in a 50mL Conical Flask containing 100mL of Distilled water as solvent and 20micro Liter of Benzyl alcohol and placed in the UV Chamber, for 5min, 10mins, 15mins, 20mins, 25mins and 30mins. At each run, the process was repeated using 0.5g, 1g, 1.5g and 2g of the photo catalyst. e Result of each process per time was transferred in a clean amber reagent bottle for GC-FID analysis of the resulting product.

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e Photo catalytic activity of the Synthesized ZnO and Zn-doped Titanium Oxide were studied by the use of Gas Chromatography-Flame Ionization Detector, using a plot of Concentration (mMol/L) vs Time (min). e purpose of the experiment, which is to investigate the photo catalytic oxidation of benzyl alcohol to benzyl aldehyde using ZnO and Zn-TiO_2 nanoparticles as catalysts.

e photo catalytic conversion of BA (Benzyl alcohol) using ZnO and Zn-TiO_2 respectively with respect to Catalyst Loading at 0.5g, 1.0g, 1.5g and 2g. Catalyst loading at 0.5g of ZnO for BA conversion was observed at high concentration and BA was converted on a steady state with initial time 0 – 4 mins, a er which a considerable decline was observed in the plot with increase time, whereas at 2.0 ZnO catalyst loading, the conversion of BA occurred rapidly and further conversion was completed with increased time. is implies that Catalyst loading of ZnO at 2.0g shows high or preferential BA photo catalytic conversion.

Catalyst loading of Zn-TiO_2 at 0.5g for BA conversion was not e cient as the conversion experienced less conversion rate as seen in the plot. Whereas Catalyst loading of Zn-TiO_2 at 2.0g for BA conversion was sharp and occurred in a steady state with increase in time. us for Zn-TiO_2 catalyst loading at 0.5g the conversion is low whereas for catalyst loading at 2.0g, the BA Conversion rate is e cient.

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