In this work, Y-doped ZnO nanoparticles were precipitately synthesized for ~~different~~ various yttrium molar ~~percentages~~ percentage values of 0-5%, and ~~the nanoparticles~~ were then demonstrated as photocatalysts for methylene blue degradation. Morphology ~~shows~~ demonstrates that the particle size of pure ZnO is 113.77±33.26 nm, which decreases to the minimum value of over one-third ~~-~~for the Y-doped ZnO samples. ~~The~~ This decrease in particle size~~s~~ is consistent with the small crystalline size, primarily due to low crystallization in the presence of yttrium dopants. However, the expansion of the crystal structure is observed. Chemical surface structures point to the major vibration of ZnO~~, however~~. However, some carbon-relating groups ~~are still~~ remain to appear~~ed~~. Optical property reveals similar trends for all Y-doped ZnO samples. The estimated band gap energy ($E_g$) ~~is~~ was reduced to the minimum value for the 4 mol.% condition. For use as a photocatalyst, the appropriate Y-doped ZnO for yttrium dopants of 4 mol.% present~~s~~ the ~~best~~ optimal degradation efficiency of 61.19%. ~~The~~ This improvement in photocatalytic degradation is caused by the synergy of decreased particle size and reduced $E_g$. Therefore, yttrium plays ~~the~~ a role to decrease particle size and reduce $E_g$ of Y-doped ZnO materials, ~~which~~ thus ~~leads~~ leading to improved photocatalytic performance.

## 1. Introduction

Pollution~~s~~ in water resources are ~~the~~ a concerning issue that has had negative ~~potentially a~~effects ~~to~~ on both human health and the surrounding environmental system. Toxic chemicals~~,~~ ~~has been~~ made by human ~~activity~~activities~~,~~ are the major pollutants that ~~have~~ continue to contaminate ~~in~~ the soil, air and water in the surrounding environment~~s such as soil, air, and water~~. ~~Especially the~~ In water, ~~the~~ chemicals ~~has~~ cause~~s~~ wastewater, which is a worrying issue and ~~because it~~ has a large-scale impact ~~to~~ on the environment, ~~in large scales due to~~ especially if it is ~~transportation~~ transported ~~of water in~~ to natural rivers. ~~To reduce chemical residues, t~~P~~he p~~hotocatalytic degradation is ~~one of the~~ an ~~interesting~~ effective method~~s~~ to reduce chemical residue, due to its simple and flexible uses [1]. ~~The p~~Photocatalytic degradation is based on two -fundamental processes, ~~including~~ namely, photoactivation and degradation~~ processes~~. ~~The p~~Photoactivation ~~has~~ occur~~red~~s when photocatalysts absorb energy from incident light for generating electron-hole pairs, which are continuously transferred to the photocatalyst's surface~~s~~. ~~Then, t~~The pairs ~~have~~ react~~ed~~ with chemical residue~~s~~ for mineral transformation ~~in~~ during the degradation process.

Several ~~semiconducting~~ semiconductor materials such as $TiO_2$, CuO, $SnO_2$, and ZnO have been investigated ~~for applying~~ as photocatalysts [2,3,4]. Among these, ZnO is an interesting one, primarily due to ~~the~~ its stability and unique ~~in~~ opto-electronic propert~~y~~ies~~and stability~~. ZnO has a large band gap ($E_g$) of around 3.70 eV that can be specifically activated by ultra-violet (UV) light; a high carrier mobility for rapidly transferring electron-hole pairs to the material's surface~~s~~; and a relatively stable chemical structure [4]. Moreover, ZnO ~~is~~ also has advantages in ~~the~~ various nano-structural fabrications. To improve the photocatalytic activity of ZnO, it has been demonstrated ~~in several developments such as~~ with several improvements in charge separations, lifetimes, and surface areas. Phopayu *et al.* () modified ZnO by using graphene quantum dots (GQDs) dopant for extending the crystalline structure of the GQDs-ZnO nanocomposites [5]. The extended structure has reducing grain boundary density, ~~which~~ thus ~~causes~~ causing a lower electron-hole pair recombination at the grain boundary. This behavior plays the role to increase the lifetimes for electron-hole pair movement at surfaces of the GQDs-ZnO, which ~~resulted~~ results in high photocatalytic performance for commercial glyphosate degradation. Bozetine *et al.* () presented the simple and green synthesis of ZnO/carbon quantum dots (CQDs)/Ag nanoparticles (NPs) nanocomposites for photocatalytic application. The nanocomposites exhibited ~~an~~ excellent photocatalytic performance due to the improved charge separation efficiency and increased surface area~~s~~ [4]. The charge separation ~~was~~ improved because electrons can ~~easier~~ easily be transferred in the nanocomposites ~~which~~ caused by the energy level adjustment for heterojunction interfaces. This result ~~agrees~~ is in line with ~~to~~ several composite structures reported ~~in~~ elsewhere [6-8]. For the increased surface area~~s~~, it was described by the attachment of small CQDs or Ag NPs on the ZnO surface~~s~~. The improved charge separation efficiency and increased surface areas of ZnO/CQDs/Ag NPs nanocomposites ~~was~~ synergistically enhanced the photocatalytic degradation of methylene blue (MB). Yu *et. al.* () developed ZnO/biochar nanocomposites using a facile ball-milling method ~~for applying~~ as a photocatalyst [9]. The nanocomposites exhibited ~~the~~ increased mesopore and macropore structures ~~in comparison~~ compared to pure ZnO. In photocatalyst applications, the degradation efficiency of MB ~~was up~~ peaked at ~~to~~ 95.19% under visible light activation. The improvement in degradation efficiency was caused by the combination of adsorption and photocatalysis processes. Wang *et. al.* () prepared Ce-doped ZnO using a simple solution method [10~~].~~ ], ~~They~~ and found that Ce-dopant ~~has affected~~ caused a ~~on the~~ decrease~~s~~ in particle size~~s~~ and $E_g$ values. These results synergistically function to improve photocatalytic activity, which subsequently enhanced the degradation efficiency of MB.

In the current work, Y-doped ZnO photocatalysts were synthesized from ~~the~~ a mixture of zinc nitrate and yttrium nitrate. The yttrium nitrate ~~was~~ varied in the molar percentage range of 0-5% to investigate the influence of yttrium on structural, chemical, and optical properties. The ~~Characteristics~~ characteristics of Y-doped ZnO were investigated and analyzed. ~~Then, t~~The Y-doped ZnO ~~were~~ was use as a photocatalyst for MB degradation. The ~~Photocatalytic~~ photocatalytic degradation efficiencies ~~were~~ was calculated~~,~~ based on the absorbance measurement~~,~~ in order to evaluate the appropriate yttrium content of Y-doped ZnO for ~~the best~~ optimum MB degradation.