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**SYNTHESIS OF ZnS LOADED WITH TRANSITION METAL USING  
IMPREGNATION METHOD FOR REDUCTION OF 4-NITROPHENOL**

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IMPREGNATION METHOD FOR REDUCTION OF 4-NITROPHENOL**

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## ABSTRACT

### SYNTHESIS OF ZnS LOADED WITH TRANSITION METAL USING IMPREGNATION METHOD FOR REDUCTION OF 4-NITROPHENOL

Organic pollutants such as 4-nitrophenol (4-NP) pose serious environmental challenges due to their chemical stability, thus requiring the development of efficient catalytic materials to facilitate their reduction into less harmful compounds like 4-aminophenol. In Advanced Oxidation Processes (AOPs), heterogeneous photocatalysts based on ZnS offer a prospective treatment method; nonetheless, ZnS has specific limitations, prompting modifications to the photocatalyst to enhance the breakdown of organic compounds. In this regard, the present work involves synthesizing ZnS loaded with transition metals, including Ag, Cu, Co, and Fe, by the impregnation method and then the prepared photocatalysts were evaluated for the efficiency of catalytic reduction of 4-NP to 4-aminophenol (4-AP). The physicochemical properties of the prepared catalysts were characterized by UV-Vis/DRS, FTIR, and FESEM to determine the optical, functional group, and morphology, respectively. From the result, Ag/ZnS showed the highest 4-NP reduction (71%) followed by Cu/ZnS (52%), Fe/ZnS (48%), Co/ZnS (23%) and ZnS (10%). The highest photocatalytic activity of Ag/ZnS is attributed to its well-dispersed Ag on the surface ZnS. This well dispersion contributes to the great interaction between Ag and ZnS, which led to the narrowed band gap energy from (3.32 eV to 2.11 eV) that induced the charge separation and better light harvesting in the visible region. Consequently, a scavenger experiment confirmed that bulk hydroxyl radicals ( $\bullet\text{OH}_{\text{bulk}}$ ) and photogenerated electrons are the primary species responsible for 4-NP reduction. This study demonstrates the potential of transition metal-loaded ZnS as an affordable yet highly effective photocatalyst for water treatment. It is hoped that this research will aid in designing more sustainable and efficient photocatalysts that can be produced on a large scale for removing hazardous organic pollutants from wastewater.

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