International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 14s,2025
https://theaspd.com/index.php

Synthesis Of 2-Aminothiazole From Methyl Carbonyl Compound Using Zno Nanoparticles -Chloramine-T Catalytic System

Dr. V. Priya[1], Dr. M. Subalakshmi[2], Dr. S. Vinotha[3]
[1]Assistant Professor, PG and Research of Chemistry, Holy Cross College (Autonomous) Affiliated to Bharathidasan University, Tiruchirappalli – 620 002, Tamil Nadu, India, priyavhcc@gmail.com
[2]Assistant Professor, Department of Chemistry, Pavendar Bharathidasan College of Engineering and Technology, Tiruchirappalli.
[3]Assistant Professor, PG and Research of Chemistry, Seethalakshmi Ramaswami College (Autonomous) Affiliated to Bharathidasan University, Tiruchirappalli – 620 002, Tamil Nadu, India

Abstract
Metal oxide nanoparticles have been receiving considerable attention for their potential applications in optoelectronics, nano sensors, nano devices, nano electronics, information storage and catalysis. An efficient protocol is developed for the synthesis of 2-aminothiazole from chloroacetaldehyde using zinc oxide nano particles-chloramine -T reagent catalytic system. The zinc oxide nanoparticles were characterized by using ultraviolet spectroscopy and FT-IR spectroscopic study, EDX and SEM. In the present study, ZnO/Chloramine-T has been introduced as new, mild, stable and excellent catalytic system for the synthesis of 2-aminothiazole from thiourea, which has an important role in synthetic and medicinal chemistry.

INTRODUCTION

The majority of the present discussions, definitions, and attention is focused on nanotechnology, despite the fact that the scientific community is interested in the topic of nanoscience.[1-3] Thus, it symbolizes a wide idea that demonstrates how man's never-ending quest for knowledge has culminated. possibility of caliber. The definition of a nanotechnology is the usage of atoms and molecules to generate useful structure at the nanoscale, which has practical applications. "Technology on the nanoscale" is the most basic definition of nanotechnology, Systems and materials related to nanotechnology have parts and structures that, due to their nanoscale size, exhibit innovative, greatly improved chemical, physical, and biological properties, processes, and phenomena[4-6].

Aminothiazole

Heterocyclic compounds are extremely valuable due to their numerous applications. A significant number of heterocyclic compounds containing nitrogen and sulphur are employed as medicine in various therapeutic goals. [7-9] Thiazole is a significant pharmacophore in the drug research and development processes. There are numerous substituted thiazole-containing heterocycles with antibacterial, anti-cancer, anti-inflammatory, and anti-HIV activity.[10-12]

N-Halo Compouds

It takes skill and difficulty to use reagents to create unique synthetic processes in organic chemistry. Because of this, major efforts have been undertaken over the years to create new reagents that can lessen the drawbacks of those now in us. [13-16] N-halo compounds are adaptable chemicals that have been exploited as potentially reactive intermediates in many organic synthesis processes.

Materials And Methods

Zinc oxide nanoparticle (ZnO NPs) synthesis:

A solution was prepared by dissolving 0.7g of zinc sulfate and 0.2g urea in 100ml distilled water. In a separate beaker,1g of NaOH solution was prepared by dissolving in double distilled water. Then on combination, the solution turned bluish white colour and the solution was kept in microwave oven for 5 minutes and the white nanoparticle got settled which indicated the formation of ZnO nanoparticles. The nanoparticles obtained has been dried in hot air oven at 60 ºC for an hour.

Synthesis of 2- aminothiazole:

A mixture of acetaldehyde(0.5equiv.), and chloramine-T, zinc oxide nanoparticles in CH3OH(2ml) at 65°C was stirred for 1 hour. Then thiourea (0.5equiv.) was added to the mixture and was stirred for 1 hour. After

completion of reaction, the reaction mixture was filtered off and the filtrate was washed by sodium bicarbonate solution and brine extracted with ethyl acetate. The organic layer was separated out followed by drying using anhydrous sodium sulfate and concentrated under reduced pressure to afford the precipitate. The solid obtained was crystallized from a mixture of water or ethanol.

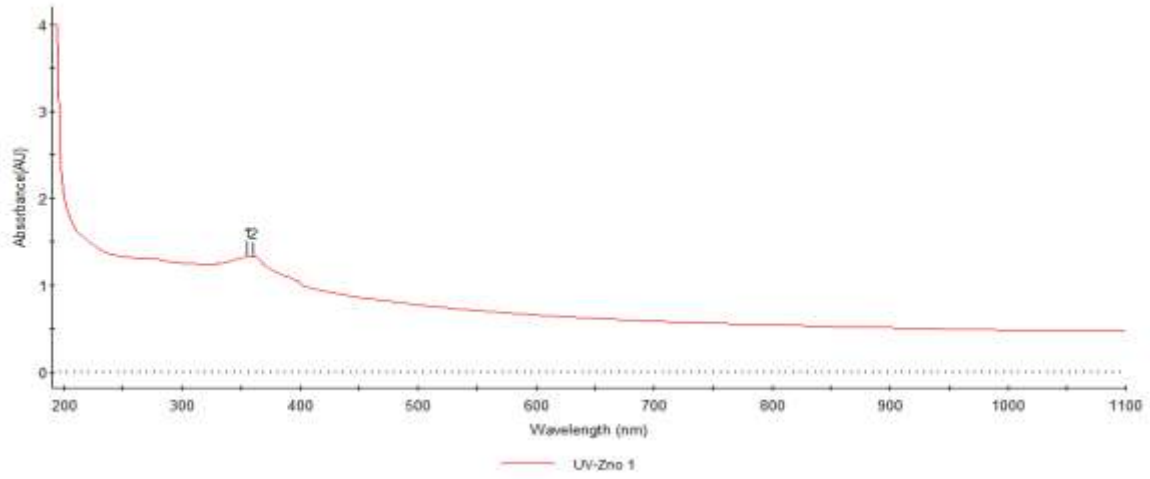
RESULTS AND DISCUSSION

The ZnO nanoparticles was characterized by UV-Visible spectral studies, Fourier Transform, Infra-Red spectral analysis, Scanning Electron Microscope (SEM) and Energy Dispersive X ray spectroscopy (EDAX).

CHARACTERIZATION OF ZINC OXIDE NANOPARTICLES

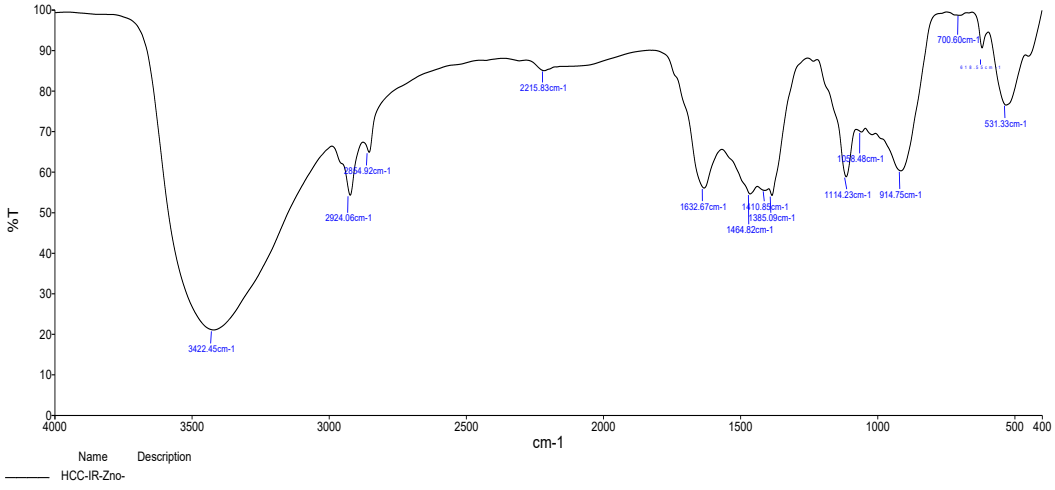
5.1.1UV-VISIBLE spectral analysis of zinc oxide NPs:

UV-Vis spectroscopy is widely accepted for examining size and shape-controlled nanoparticles in aqueous solutions. The UV-Vis spectrum of ZnO-NPs showed two peaks at 355.45nm, 1.330nm, and 360nm,1.328nm. Fourier Transform Infra-Red spectral analysis of ZnO NPs:



Name	No.	Peak(nm)	Peak(AU)	No.	Valley(nm)	Valley(AU)
UV-Zno	1	355.45	1.330			
	2	360.40	1.328			

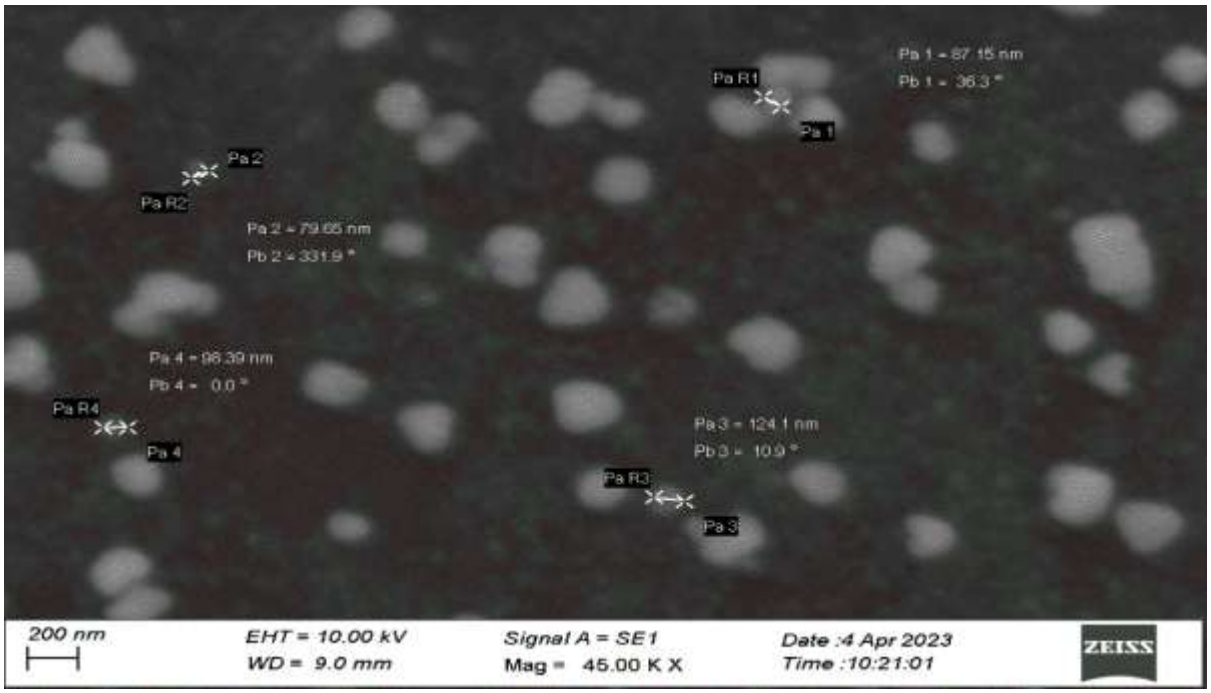
Fourier Transform Infra-Red spectral analysis of ZnO NPs has been carried out. The FT-IR spectra of ZnO nanoparticles has been investigated in order to discover the probable biomolecules responsible for capping and efficient stability of the produced ZnO nanoparticles.



Scanning Electron Microscopy(Sem)

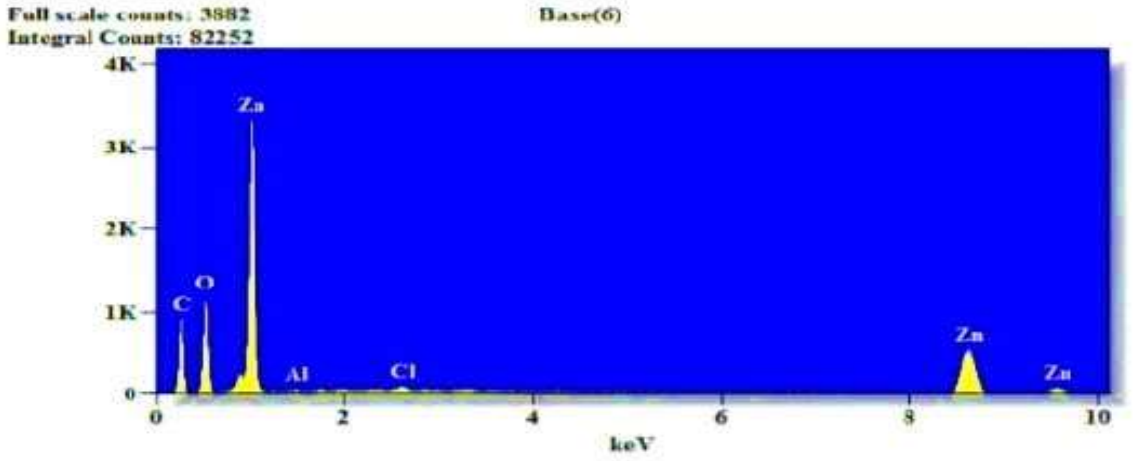
The SEM analysis was used to determine the structure of the reaction products formed . SEM image was shown to have individual zinc particles as well as number of aggregates. The SEM image showed the range from

07 – 87nm spherical shape nanoparticles formed with the diameter range 200nm. Most of the scattered nanoparticles scattered has been observed under SEM.



EDAX Observation of Zinc Oxide Nanoparticle

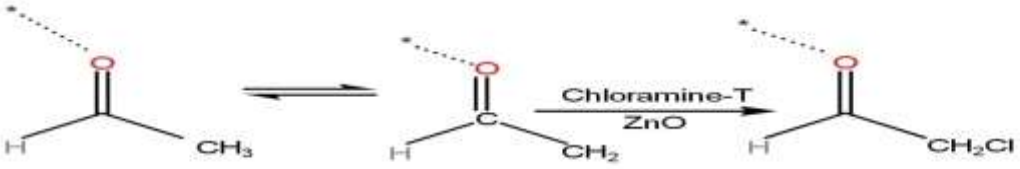
The elemental spectrum shows distinct peaks for zinc and oxygen, with a composition of 48.57%, indicating that the synthesized zinc oxide nanoparticles are largely free from impurities. The elemental composition of ZnO NPs is confirmed by the EDAX analysis of zinc oxide nanoparticles. The amount of oxygen and zinc in ZnO NPs were individually quantified by EDAX analysis.



Mechanism For The Synthesis Of 2-Aminothiazole From Zinc Oxide Nano Particles- Chloramine-T Catalytic System:

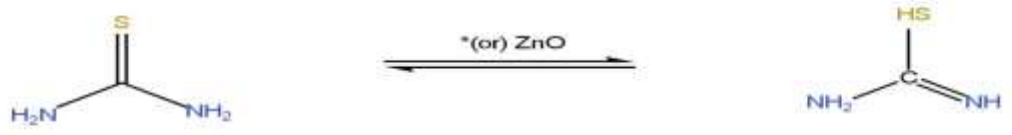
A proposed mechanism for the production of 2-aminothiazole is presented in below. ZnO nanoparticles as the catalyst can activate the acetaldehyde to enolize through coordination to the oxygen atom of carbonyl group and accelerate the chlorination of alpha position by Chloramine-T (C). Furthermore, the catalyst can participate in the conversion of (D) to (E). The chlorinated acetaldehyde react with carbamimidothioic acid species (E) and result in 2-oxo-2-phenylethyl carbamimidothioate intermediate (G). The catalyst participates in this nucleophilic substitution by coordination to the oxygen of carbonyl group. Finally, ZnO nanoparticles promote dehydrogenation of (G) and followed by the neutralization of (H) gives 2-aminothiazoles (I).

STEP 1:



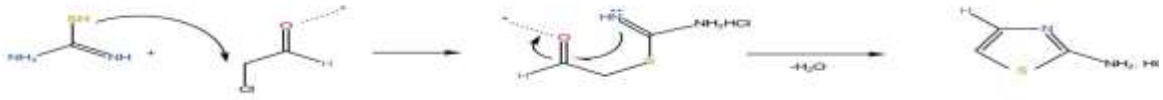
A B C

STEP 2:



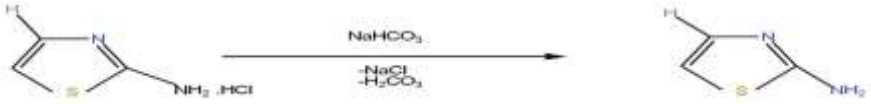
D E

STEP 3:



F G H

STEP 4:



H I

CONCLUSION

In the present study, 2-aminothiazole is synthesized from acetaldehyde using zinc oxide nano particle-chloramine-T catalytic system. The synthesized zinc oxide nanoparticle is characterized by UV, IR and SEM analysis. A suitable mechanism is proposed for the synthesis of 2-aminothiazole. A novel and efficient catalytic system comprising ZnO and Chloramine-T has been developed for the synthesis of 2-aminothiazole from thiourea. This system is mild, stable, and offers excellent catalytic performance, highlighting its potential significance in synthetic and medicinal chemistry.

REFERENCES

1. Nasrollahzadeh, M., Sajadi, M., & Sajjadi, M. (2019). An introduction of nanotechnology. In Interface Science and Technology (Vol. 28). Elsevier.
2. Bayda, S., Adeel, M., & Rizzolio, F. (2019). The history of nanoscience and nanotechnology. Nanomaterials, 9(10), 1417. https://doi.org/10.3390/nano9101417
3. Lothenbach, B., Scrivener, K., & Hooton, R. D. (2011). Supplementary cementitious materials. Cement and Concrete Research, 41(12), 1244–1256. https://doi.org/10.1016/j.cemconres.2010.12.001
4. Snellings, R., Mertens, G., & Elsen, J. (2012). Supplementary cementitious materials. Reviews in Mineralogy and Geochemistry, 74(1), 211–278. https://doi.org/10.2138/rmg.2012.74.6
5. Panyam, J., & Labhasetwar, V. (2012). Biodegradable nanoparticles for drug and gene delivery to cells and tissue. Advanced Drug Delivery Reviews, 64(Suppl), S61–S71. https://doi.org/10.1016/j.addr.2012.09.025

6. Christian, P., Von der Kammer, F., Baalousha, M., & Hofmann, T (2008). Nanoparticles: structure, properties, preparation and behaviour in environmental media. Ecotoxicology, 17, 326-343.
7. Gopala, L., Liu, H., et al. (2017). Novel naphthalimide aminothiazoles as potential multitargeting antimicrobial agents. ACS medicinal chemistry letters , 8, 1331–1335.
8. Cordeiro, Y., & Ferreira, N. C. (2015). New approaches for the selection and evaluation of anti-prion organic compounds. Mini Reviews in Medicinal Chemistry, 15, 84–92.
9. Ran, K., & Gao, C. (2016). Identification of novel 2-aminothiazole conjugated nitrofuran as antitubercular and antibacterial agents. Bioorganic & medicinal chemistry letters, 26, 3669–3674.
10. Sridhar, S., Pandeya, S., & De Clercq, E. (2001). Synthesis and anti-HIV activity of some isatin derivatives. Bollettino Chimico Farmaceutico, 140, 302.
11. Kabra, V., Mitharwal, S., & Singh, S. (2009). Synthesis and insecticidal activity of novel dithiophosphonates. Phosphorus, Sulfur, and Silicon and the Related Elements, 184, 2431–2442.
12. Panico, A. M., Geronikaki, A., et al. (2003). Aminothiazole derivatives with antidegenerative activity on cartilage. Bioorganic & Medicinal Chemistry, 11, 2983–2989.
13. Negi, A. S., & Anand, S. C. (2007). A textbook of physical chemistry (2nd ed.). New Age International Publishers.
14. Dake, G. R., Fenster, M. D. B., Hurley, P. B., & Patrick, B. O. (2004). Synthesis of functionalized 1-azaspirocyclic cyclopentanones using Bronsted acid or N-bromosuccinimide promoted ring expansions. Journal of Organic Chemistry, 69, 5668.
15. Rodrigues, R. C., Barros, I. M. A., & Lima, E. L. S. (2005). Mild one-pot conversion of carboxylic acids to amides or esters with Ph3P/trichloroisocyanuric acid. Tetrahedron Letters, 46, 5945.
16. Bandgar, B. P., Uppalla, L. S., & Sadavarte, V. S. (2001). Chemoselective transesterification of β-Keto esters under neutral conditions using NBS as a catalyst.. Synlett, 2001(11), 1715.
17. Li, G., Kim, S. H., & Qei, H. W. (2000). α, β-Differentiated tandem diamination of cinnamic esters using N, N-dichloro-2-nitrobenzenesulfonamide and acetonitrile as the nitrogen sources. Tetrahedron Letters, 41, 8699.
18. Kolvari, E., Ghorbani, A., Salehi, P., Shirini, F., & Zolfigol, M. A. (2007). Application of N-halo reagents in organic synthesis. Journal of the Iranian Chemical Society, 4, 126.
19. Farook Mohamed, N. A. (2006). Kinetics and mechanism of oxidation of 4-oxoacids by N-bromosuccinimide in aqueous acetic acid medium. Journal of the Iranian Chemical Society, 3(4), 378.
20. Bachhawat Koul, A. K., Bhagawath Prasad, Gowda, N. S., Narangad, C. W., & Mathur, N. K. (1973). Indian Journal of Chemistry, 11, 609.
21. Vivekanandan, K., & Nambi, K. (1996). N-chloronicotinamide: a new, mild, stable, efficient and inexpensive oxidant for organic substrates, Indian Journal of Chemistry Section B: Organic Chemistry Including Medicinal Chemistry, 35B, 1117.