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Synthesis of $NaAlZrO_3$ Ceramic Nanodiscs and It's Biological Applications[1]

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ABSTRACT

A new disc shaped $NaAlZrO_3$ mixed oxides were synthesized by co-precipitation method and this disc shaped mixed metal oxides were confirmed by characterization such as XRD, PL Emission, UV spectra, SEM, FTIR. Also its biological applications like antimicrobial activity and water remedial activity were studied from this study it has been observed that the mixed metal oxide $NaAlZrO_3$ is good material for preparation of ceramic membrane.

KEYWORDS : *Mixed metal oxide, disc shape, highly porous, antimicrobial and water remedial activity.*

INTRODUCTION

Nanotechnology has emergent research fields which are growing towards development of new class of ceramic metal oxide materials used for water remediation. Ceramic metal oxide nanoparticles and nano composites are having suitable applications for antimicrobial and cleansing of water pollutants and agents. Limited number of reports have been attempted and published by researchers in this field.[1-5] So there is need of development of new class of cheaper and suitable nano composite mix metal oxide ceramic material to kill microbial contents of water resources to generate good quality of potable water.[6-9]

With this idea in the field of ceramic water nanotechnology, here in this research work we had developed $NaAlZrO_3$ a new class of trio metal oxide ceramic nano composite material for microbial remediation of surface water resources. Aluminium and zirconium based materials are used nowadays for antimicrobial applications in various fields.[10-14] Along with sodium it can form stable mix metal oxide to result trio metal ceramic type material with good expected porosity. Porosity is mainly important for water remediation and antimicrobial effects of bacterial cell adhesion. Newly synthesized this mixed metal oxide ceramic nano composite for such porosity required for antimicrobial effects and future water remediation application.[15-16]

Hydrogen peroxide is the major theme for this application of ceramic nano composites as these materials generate peroxide entities with porous surface in water. So in continuation with these ideas we had also explained the suitable mechanism for antimicrobial activity of this ceramic material in our research work. So this material can be used not only for antimicrobial application but also for water remediation. [17-20]

The cell-particle interactions of materials demonstrating their reactivity and biocompatibility can be elaborated using simple *in vitro* antibacterial screening in buffer solutions. As cell pH affect on the biocompatibility of molecules. Here in this work 20 ppm. Concentrations of inside the wells bored on plates. The gram negative bacteria *E. Coli* was grown on culture plates and inhibited by dosing of material solutions in buffer dispersions with physiological pH = 7.4 by use of phosphate buffer. The culture plates were incubated and zones of inhibition were measured, and biocompatibility/ antimicrobial property of nanocomposite was elaborated.[26-30]

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Synthesis : $NaAlZrO_3$

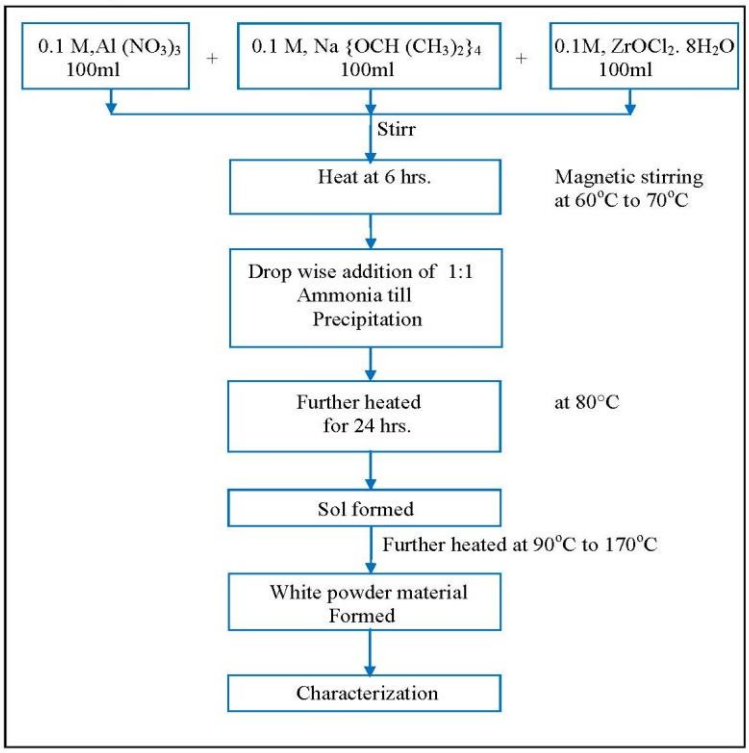

Fig.3.5 Flow sheet diagram of $NaAlZrO_3$ nanomaterial

Antimicrobial properties for water remediation of nano material $NaAlZrO_3$:

In our present research work, for antimicrobial activity, we have selected *E.Coli* gram- ve microorganism. This microorganism is inoculated in petri dish with our ceramic composite nano material $NaAlZrO_3$. Then it has been observed that after 48 hrs. This species *E.Coli* (gram-ve) bacteria shows good zone of inhibition.

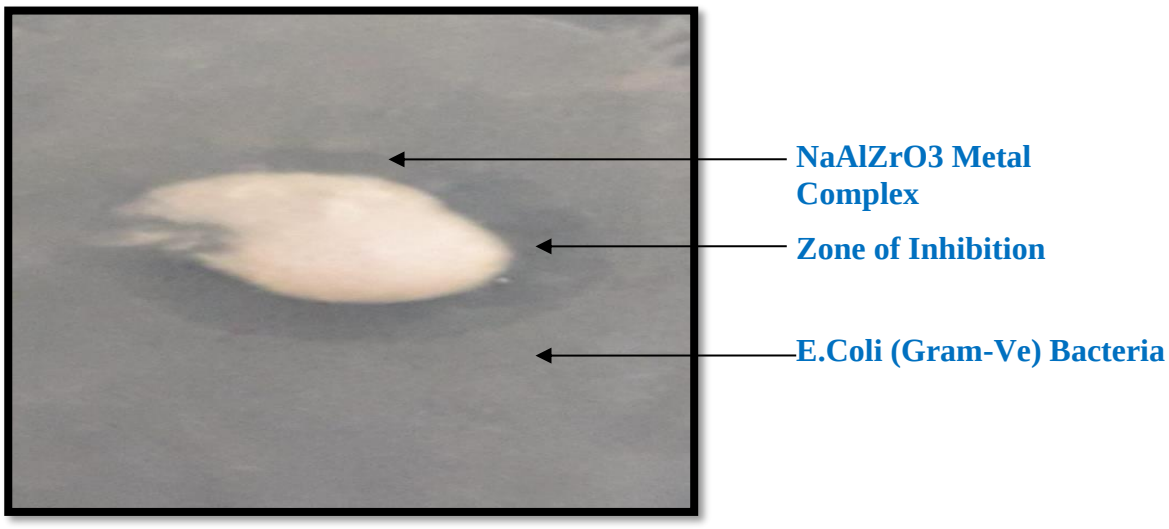

Fig. : Anti microbial effects of ceramic nanomaterial on E. Coli for zone of inhibition at 20 ppm.

Table : Anti-microbial activities of Schiff base and complex compared for gram positive and gram negative bacteria.

Type/ name of bacterial culture in Agar broth [as per figures]	Zones of inhibition for gram negative bacteria as zone diameter in mm. for Concentrations of drug/ dose of ceramic nanomaterial	
	At 10 ppm.	At 20 ppm. Fig.
E. Coli (gram -ve)	12 mm.	23 mm.

As per Fig. for antimicrobial activity of 20 ppm. material on *E. Coli* ,it had been demonstrated that good zone of inhibition with better antimicrobial activity.

MECHANISM FOR ANTIMICROBIAL ACTIVITY AND WATER REMEDIATION ACTIVITY :

The disc nanomaterial trio metal oxide ceramic nanocomposite exhibit antimicrobial and water remediation potential at surface by material cell interactions. Here as material have surface porosity after reaction with cell membrane material and water the surface of material show adhesion to liquid and biomaterials which result in dissociation. This peroxide produced at surface of nanomaterial further can produce oxide and super oxide radicals to give antimicrobial effects for water remediation activity.

WATER REMEDIATION ACTIVITY OF $NaAlZrO_3$

λ Max is 660mm. At this λ max, methytene blue dye with concentration 20ppm has been used. This concentration is prepared as 150mg/100ml. it is photocatalyst amount. Sample is observed in total 180 min of an interval of 30 min. pH of solution is maintained 7 and source of light is 365 nm Hg vapour lamp.

In the mechanism of water remediation, it has been observed that mixed metal oxide acts as a catalyst. This mixed metal oxide reacts with methylene blue dye with living behind H_2O_2. This H_2O_2 acts as a strong oxidizing agent known as peroxide generation which disintegrates the activity of microorganisms. Thus, it disappears the colour of methylene blue in 180 min. The percentage degradation is 10%. The water free from methylene blue indicator acts as a potable water.

Scheme 1

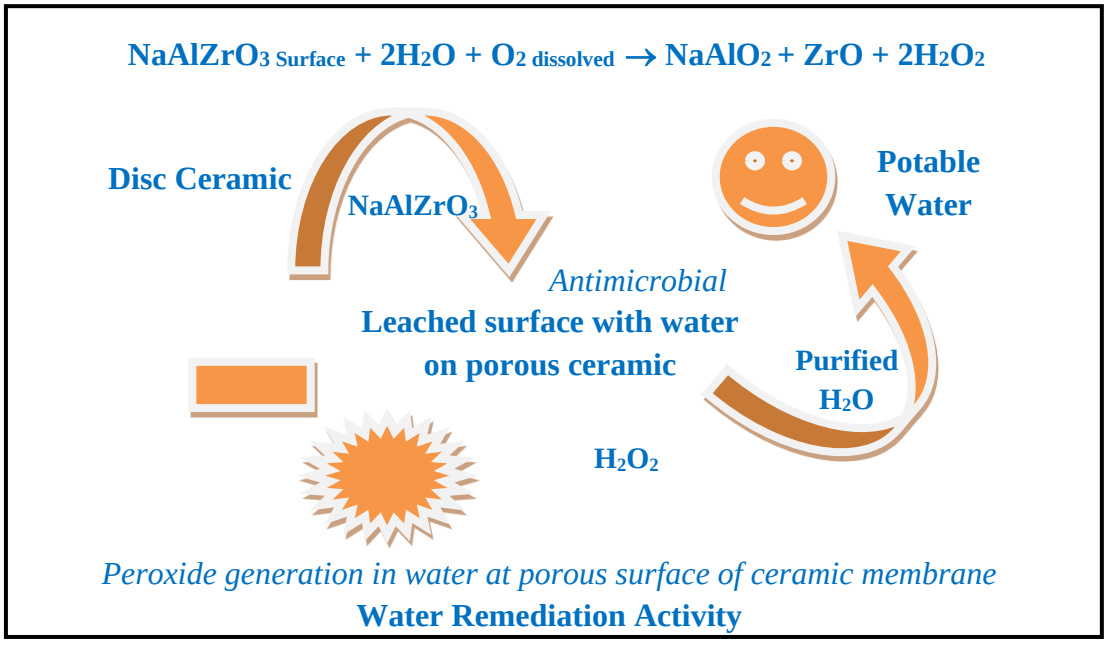

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Table No. : Degradation parameters

1.	Dye	Methylene Blue
2.	Concentration	20 ppm
3.	Photocatalyst's amount	150mg/100mL
4.	Degradation Time	180 min
5.	Degradation Efficiency	10%
6.	pH	7
7.	Source of light	365 nm Hg Vapor lamp

Table No. : Percentage degradation during course of time

Time	**% Degradation of MB**
Blank	00
Adsorption	0.8
30 min	2.7
60 min	4.7
90 min	6.6
120 min	7.8
150 min	9.0
180 min	10.0

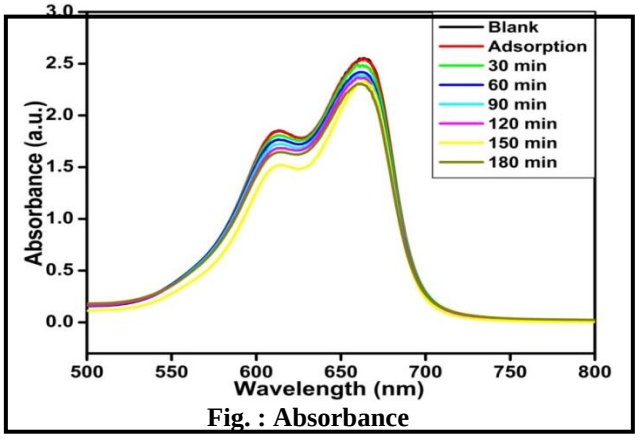

Fig. : Absorbance

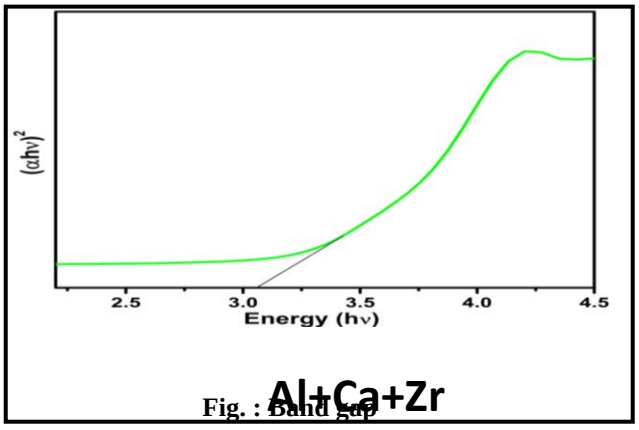

Fig. : Band gap

In testing of water remedial activity of our ceramic composite nanomaterial $NaAlZrO_3$ with methylene blue dye, the maximum band gap is 3.06 ev and it has been observed that maximum absorption is at 650nm at 180 min. indicates that colour of methylene blue dye disappears. Our nano composite material $NaAlZrO_3$ shows good water remedial activity.

CONCLUSION:

A new disc shaped trio metal oxide based ceramic nano material was prepared by using simple wet chemical and drying route. This nano material with 65 nm. mean size. The absorption and emission spectra of nano material had proved presence oxide free electrons on surface. The nano material possess surface oxide and hydroxide species for water loving nature of material on the basis of FTIR analysis. The percentage degradation of metylene blue is 10%. Hence these evidences for nano material had elaborated its properties for antimicrobial water remediation potential. On the basis of antimicrobial testing of the material it has been determined that this disc ceramic trio metal oxide nano material finds applications in water purification and environmental fields.

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