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Subject:

CHEMISTRY

Title of Original Research Paper:

Antibacterial and Antifungal Activities of Al-Zn-Cu Mixed Oxide

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ABSTRACT

Synthesis of Al-Zn-Cu mixed oxide nanoparticles was carried out via sol-gel method by maintaining the pH around 8.Biological potential such as antibacterial and antifungal activities were also studied by using agar-diffusion method. The results reveal that the synthesized mixed oxides possessed a better antimicrobial activity than the corresponding individual oxides like aluminium oxide, copper oxide and zinc oxide.

Keywords: Al-Zn-Cu mixed oxide nanoparticles, Antibacterial, Antifungal, Sol- gel method

INTRODUCTION

Metal oxides play a very important role in many areas of chemistry, physics and materials science. The metal elements are able to form a large number of oxide compounds. Most oxides have significant degree of ionic bonding because of the most electronegative divalent oxygen atoms, which results in characteristics of ionic crystals, i.e., optical transparency, high electrical resistivity, low thermal conductivity, diamagnetism and chemical stability. In technological applications, oxides are used in the fabrication of microelectronic circuits, sensors, piezoelectric devices, fuel cells, coatings for the passivation of surfaces against corrosion, and as catalysts. In the emerging field of nanotechnology, the goal is to make nanostructures or nanoarrays with special properties with respect to those of bulk or single particle species. Oxide nanoparticles can exhibit unique physical and chemical properties due to their limited size and a high density of corner or edge surface sites. Particle size is expected to influence three important groups of basic properties in any material.

The first one comprises the structural characteristics, namely the lattice symmetry and cell parameters. Bulk oxides are usually robust and stable systems with well-defined crystallographic structures. The second important effect of size is related to the electronic properties of the oxide. In any material, the nanostruture produces the so-called quantum size or confinement effects which essentially arise from the presence of discrete, atom-like electronic states. From a solid-state point of view, these states can be considered as being a superposition of bulk-like states with a concomitant increase in oscillator strength. Structural and electronic properties obviously drive the physical and chemical properties of the solid, the third group of properties influenced by size in a simple classification. In their bulk state, many oxides have wide band gaps and a low reactivity.

EXPERIMENTAL DETAILS

Copper, Zinc, Aluminium mixed oxide were prepared by a Sol-gel method. An equimolar quantity of zinc Sulphate (1M), Copper Sulphate (1M), Aluminium Sulphate (1M) were taken in a round bottomed flask equipped with reflux condenser and refluxed for 1hour. This reaction mixture was then subjected to magnetic stirrer for 5 hours. After 5 hours, pH was maintained around 1.5 and a known volume of ammonia was added to it. The solution was allowed to stand for 2 hours for complete settlement of precipitate. Then the precipitate was filtered, and washed well with water and dried overnight in oven for 24 hours. Finally a pale green colour mixed oxide was obtained and subjected to various characterization studies.

Biological Applications:

Antibacterial activity and Anti-fungal activity:

Antibacterial activity of mixed oxide and, Aluminium oxide were evaluated against three bacterial strains by agar diffusion method. Both shows moderate activity against the listed bacteria and the results were given in table 1 . The results showed that mixed oxide showed moderate activity against all the listed bacteria whereas Aluminium oxide showed against klebsiella only. Thus synthesized mixed oxide possessed improved antibacterial activity than Aluminium oxide.

The anti-fungal tests were carried out by diffusion method for the mixed oxide and aluminium oxide and the zone of inhibition were shown in table 1 . Both aluminium and mixed oxide shows moderate activity against Candida albicans whereas, both shows least activity against Candida parapsolisis.

Table: 1. Antimicrobial activity of metal oxide

Sample I-Aluminium oxide **Sample II-Mixed oxide**

Sample	Anti-bacterial zone of inhibition(mm)			Anti-fungal zone of inhibition(mm)	
	E.coli	Klebsiella	Pseudomonas aeruginosa	Candida albicans	Candida parapsolisis
Sample I	-	10	-	10	-
Sample II	9	7	11	16	-
Control	15	13	15	28	28

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Fig 1. Antibacterial activity of mixed oxide

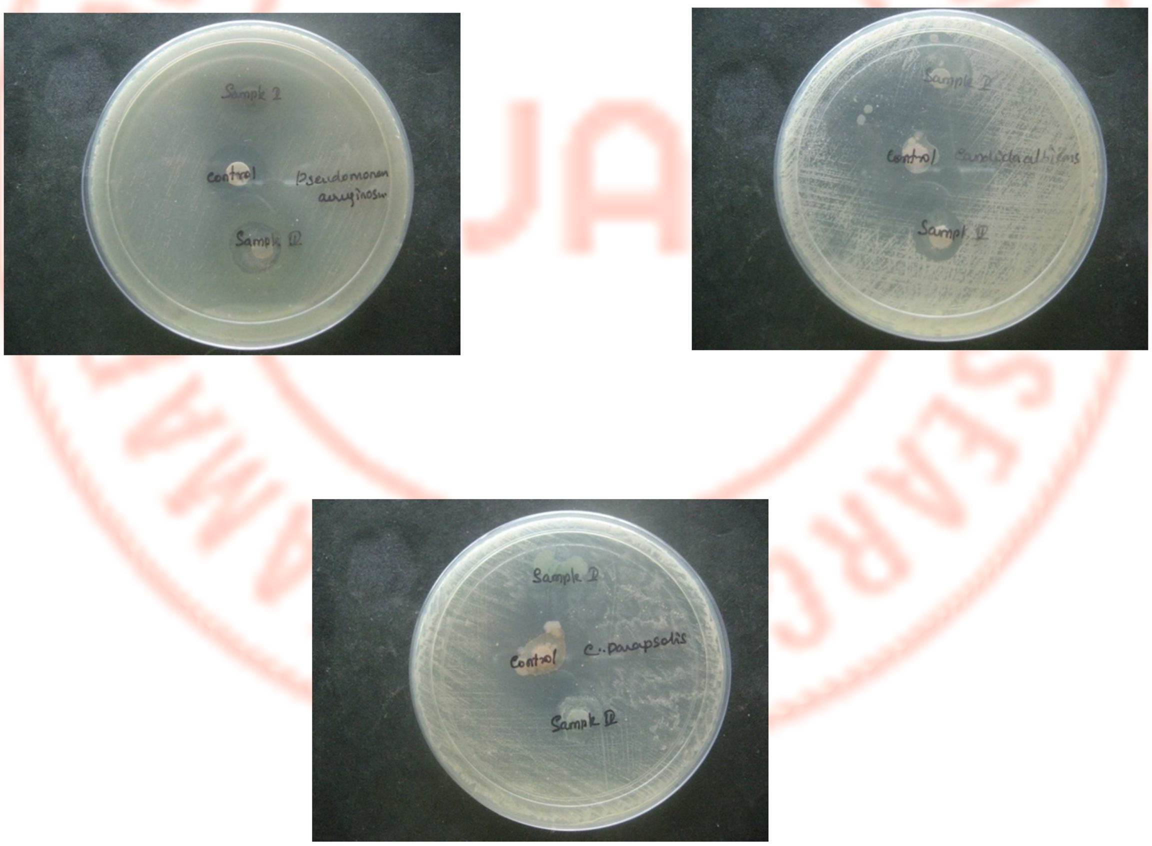

Fig .2. Antifungal activity of mixed oxide

CONCLUSION

The mixed oxide containing Al,Zn,Cu was prepared by sol-gel and subjected to antimicrobial studies and were concluded as follows:

The antimicrobial activity of the synthesized mixed oxide shows moderate activity against the 3 bacterial and 2 fungal strains. It possesses good antimicrobial activity.

Hence the mixed oxide can be used as antimicrobial agent can be further investigated for medicinal applications.

REFERENCES

1. Noguera, C. Physics and Chemistry at Oxide Surfaces; Cambridge University Press: Cambridge, UK, 1996.
2. Wyckoff, R.W.G. Crystal Structures, 2nd ed; Wiley: New York, 1964.
3. Wells, A.F. Structural Inorganic Chemistry, 6th ed; Oxford University Press: NewYork, 1987.
4. Rodriguez, J.A. Liu, G. Jirsak, T. Hrbek, Chang, Z. Dvorak, J. Maiti, A. J. Am. Chem. Soc. 2002, 124, 5247.
5. Ayyub, P. Palkar, V.R. Chattopadhyay, S. Multani, M. Phys. Rev. B. 1995, 51, 6135.
6. McHale, J.M.; Auroux, A.; Perrota, A.J.; Navrotsky, A.; Science 1997, 277, 788.
7. Samsonov, V.M. Sdobnyakov, N.Yu. Bazulev, A.N. Surf. Sci. 2003, 532-535, 526.
8. Ayyub, P.; Multani, M. Barma, M.; Palkar, V.R. Vijayaraghavan, R. J. Phys. C: Solid State Phys. 1988, 21, 229.
9. Cammarata, R.C. Sieradki, K.; Phys. Rev. Lett. 1989, 62, 2005.
10. Garvie, R.C.; Goss, M.F. J. Mater. Sci. 1986, 21, 1253.
11. Fernandez-Garcia, M., Wang, X. Belver, C Hanson, Iglesias-Juez, A.J.C. Rodriguez, J.A. Chem. Mater. 2005, 17, 4181.
12. Surnev, S.Kresse, G. Ramsey, M.G. Netzer, F.P. Phys. Rev. Lett. 2001, 87, 86102.
13. Yoffre, A.D. Advances in Physics 1993, 42,

14. Brus, L. J. Phys. Chem. 1986, 90, 2555.
15. Pacchioni, G. Ferrari, A.M. Bagus, P.S. Surf. Sci. 1996, 350, 159.
16. Mejias, J.A. Marquez, A.M. Fernandez-Sanz, J. Fernandez-Garcia, M. Ricart, J.M. Sousa, C. Illas, F. Surf. Sci. 1995, 327, 59.
17. Scamehorn, C.A.; Harrison, N.M.; McCarthy, M.I. J. Chem. Phys. 1994, 101, 1547.