Journal of Applied Science and Engineering Methodologies,
Volume.2, No.1, Page-212-215 (2016)
www.scientistlink.com

Synthesis and Characterization of Copper Oxide with Aloe Vera Capping

R.Hemamalini*, K.Mahalakshmi
Department of Physics,
Queen Mary's College, Chennai, India
**hemaphy.qmc@gmail.com*

Abstract: *Copper oxide is a ductile metal with high thermal and electrical conductivity and possesses antimicrobial properties. In the present study, pure nano CuO was successfully synthesized by sol–gel method. Aloevera a natural plant, has very strong antiseptic, anti -inflammatory, anti-viral, anti-tumor, antibacterial and immuno modulatory properties. Hence a sincere effort has been made to synthesize and study nano CuO with aloevera because a combination of this will have inhibitory action on fungi, bacteria and viruses. The CuO and CuO aloevera composition was characterized by X–ray diffraction for structural determination and estimation of crystallite size, scanning electron microscope to study the surface morphology , Ultra visible spectroscopy for energy gap, Fourier transform infrared spectroscopy to identify the functional groups in the sample and the Vibrational band assignment of the prominent peaks. The inclusion of the capping molecule Aloe Vera with CuO composition has been found to control the size and distribution. Further, anti-bacterial study by disc diffusion method on Muller Hinton agar (MHA) medium showed that nano CuO with aloe vera has microbial activity for 1000 µg/ml and 750 µg/ml.*

Keywords: *Copper oxide, Synthesis, characterization, aloe Vera*

Introduction :

Copper (II) oxide[1] belongs to the Monoclinic structure, with a Crystallographic point group of 2/m. It is a ductile metal with very high thermal and electrical conductivity and microbial activity. The morphology of copper nano particles is round, and they appear as a black to brown powder. Aloe vera[2] is a natural plant that flourishes in warm and dry climates. It contains six antiseptic agents: Lupeol, salicyclic acid, urea nitrogen, cinnamonic acid, phenols, sulphur and mucopolysaccharides (long - chain sugars) that have very strong antiseptic, anti -inflammatory, anti-viral, anti-tumor, anti irritant and immunomodulatory properties.

Material synthesis:

Analar grade Copper nitrate was mixed in 20 ml distilled water and NaOH solution was added drop by drop (molar ratio 1 : 1) at 70˚C in a magnetic stirrer for an hour. The resulting black bulky solution was dried in oven at a temperature of about 100˚C for 24 hr. The dried precursor (nano copper oxide) was crushed into powder by mortar and pestle. This was used for further synthesis and characterization. Freshly extracted aloe vera gel was stored in the refrigerator for 24 hr separately. Molar ratio of synthesized nano CuO was mixed with aloevera gel and placed in magnetic stirrer for 2 hours and then dried in an oven to get a black powder of nano CuO with cool aloevera. Then aloevera was boiled to 60˚c and placed of 1hr in the magnetic stirrer. This was added to nano CuO to synthesise with boiled aloe vera as used as capping molecule.

Results and discussion

X-ray Diffraction (XRD) Analysis :

The synthesied nano CuO, nano CuO with cooled aloe vera and boiled aloe vera samples were subjected to x-ray studies (Fig1). The peaks were similar and all three showed prominent peaks with high intensity for (002), (202) and (111) planes and they were used to find the particle size[3]. The decrease in particle size (table 1) on addition of aloevera shows that it is a good caping molecule.

ISBN: 978-93-5254-981-8

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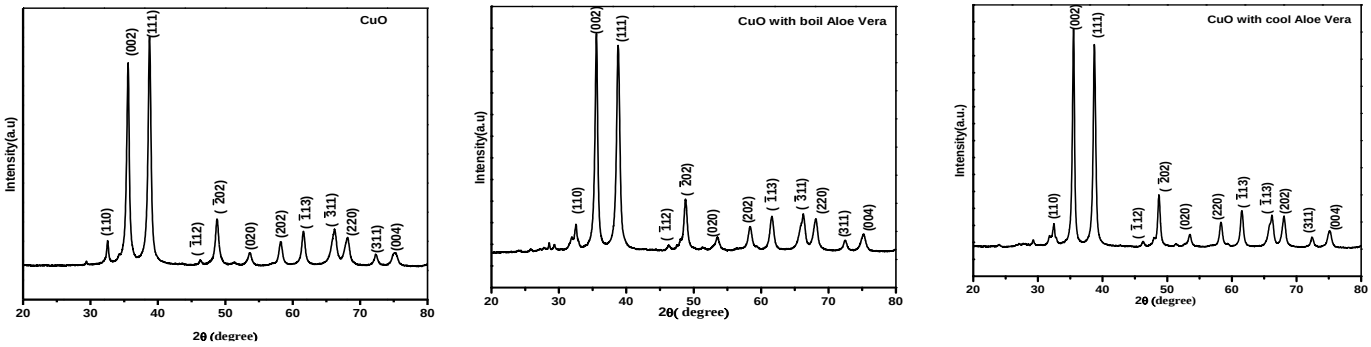


Fig. 1 XRD of nano CuO, CuO with cooled aloevera and CuO with boiled aloevera

Table 1: Particle size of nano CuO, CuO with cooled aloevera and CuO with boiled aloevera

2θ	d(ang.)	FWHM	Size
34.12	2.62	0.22	38 nm
35.56	2.52	0.41	20 nm
38.72	2.32	0.45	19 nm

2θ	d(ang.)	FWHM	Size
32.46	2.75	0.43	19 nm
35.55	2.52	0.44	19 nm
38.76	2.32	0.53	16 nm

2θ	d(ang.)	FWHM	Size
32.77	2.73	0.43	nm
35.50	2.52	0.44	nm
38.68	2.32	0.53	nm

UV-Visible Spectroscopy Analysis: The UV-VIS peak around 370 nm (Fig.2) is a significant one for the CuO and the wavelength is used to find the energy gap. It is seen that the band gap decreases on addition of cooled aloevera (Table 2). It is as significant as in XRD.

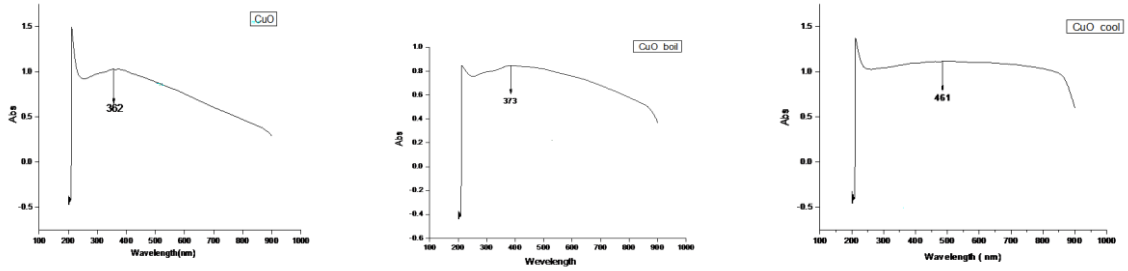


Fig.2 UV-VIS spectra of nano CuO, CuO with cooled aloevera and CuO with boiled aloevera

Table 2: Energy band gap of nano CuO, CuO with cooled aloevera and CuO with boiled aloevera

Samples	Wavelength (nm)	Energy Band Gap (Eg)
CuO	362	3.42 eV
CuO with Boiled. Aloe Vera	373	3.32 eV
CuO with Cooled.Aloe Vera	461	2.68 eV

FTIR spectra: The peak at 538cm^{-1} is a finger print of CuO molecule [3]. The vibrational band assignments in table 3 shows peaks at 1116 cm^{-1} is due to S=O stretching aloevera in the samples.

Table 3: Vibrational band assignments of functional groups

Samples	Frequency cm^{-1}				
	O-H Stretching	C- H Stretching	C= O Stretching	S = O	C- H Bending
CuO	3426	2998	1334		835
CuO with boiled aloe vera	3384	2523	1631	1116	811
CuO with cooled aloe vera	3384	2509	1634	1116	868

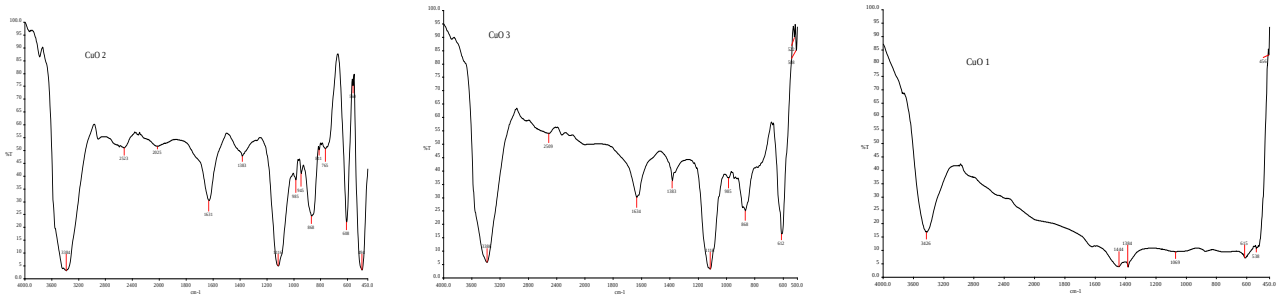
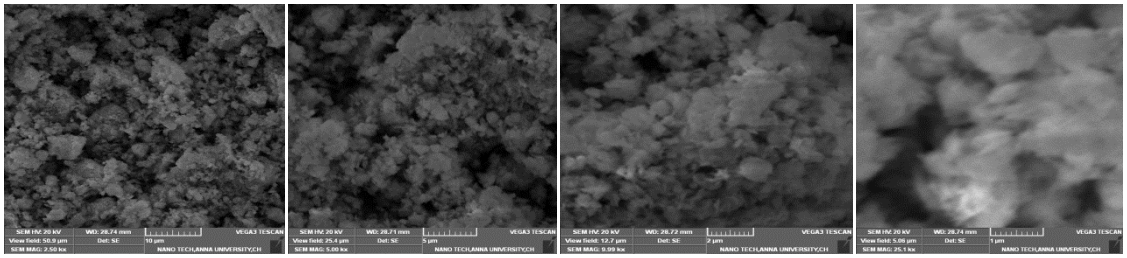


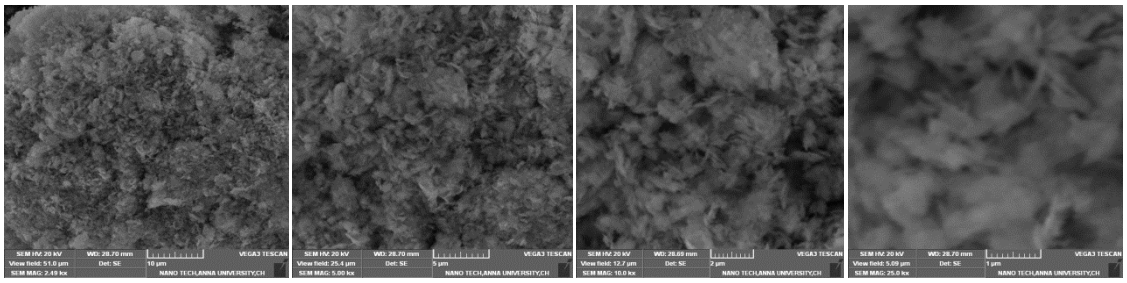
Fig.3: Fourier Transform Infrared Spectra (FTIR) of nano CuO, CuO with cooled and boiled aloevera

Scanning electron microscopy: SEM picture shows small voids and the rounded structures are that of nano CuO. The void size is lesser on addition of aloevera showing nano particle character.

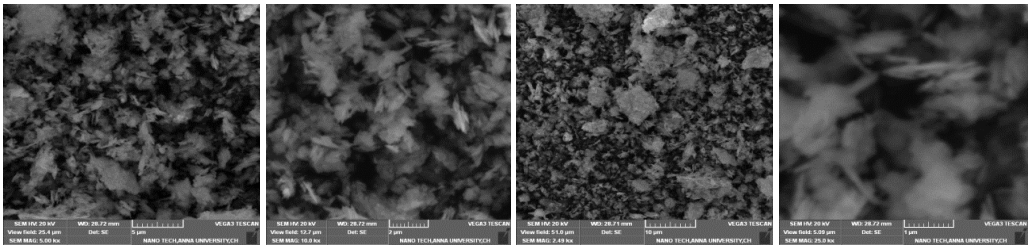
Fig. 4 Scanning Electron Microscope (SEM) of nano CuO



CuO with Boiled Aloe vera

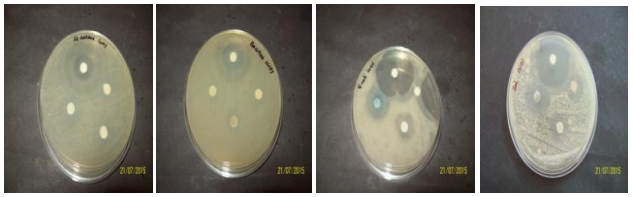


CuO with cooled Aloe vera



Antibacterial activity : Microbial activity of CuO[4] with aloevera has been studied in comparison with ampicilin on four common bacteria namely, the staphylococcus aureus, bacillussubtilus, e.coli and salmonella subtilis with amplicillin by disc diffusion technique.

Fig 5.Bacteria with CuO and boiled aloevera

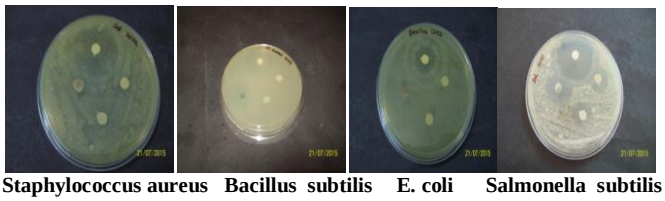


Staphylococcus aureus Bacillus subtilis E. coli Salmonella subtilis

Table 4: Zone of inhibition of bacteria with CuO and boiled aloevera

Organisms	Zone of Inhibition (mm)			Antibiotic (1mg/ml)
	Concentration(µg/ml)			
	1000	750	500	
Staphylococcus aureus	23	17	14	41
Bacillus subtilis	12	12	10	33
E. coli	21	16	-	41
Salmonella subtilis	25	19	15	35

Fig 6.Bacteria with CuO and cooled aloevera



Staphylococcus aureus Bacillus subtilis E. coli Salmonella subtilis

Table 5: Zone of inhibition of bacteria with CuO and cooled aloevera

Organisms	Zone of Inhibition (mm)			Antibiotic (1mg/ml)
	Concentration(µg/ml)			
	1000	750	500	
Staphylococcus aureus	15	9	-	32
Bacillus subtilis	12	12	-	42
E. coli	20	17	13	39
Salmonella subtilis	14	7	15	34

When concentration of CuO with boiled Aloe vera and cooled Aloe vera increases the zone of inhibition increases. With higher concentrations of the composition more inhibition can be expected and CuO with aloevera can be used an antibiotic.

Conclusion: Pure and crystalline nano CuO was successfully synthesized by sol–gel method. Further, the CuO composition was prepared with aloevera caping and characterized by XRD, UV, SEM, FTIR and the CuO composition can be used to controlled size and distribution and it has antimicrobial activity for 1000 µg/ml and 750 µg/ml and 500 µg/ml.

References :

1].The effect of hydrostatic pressure on the ambient temperature structure of CuO, Forsyth J.B., Hull S., J.Phys., Condenser of matter 3(1991) 5257-5261.

2].Aloe Barbadensis Leaf Extract, Aloe Barbadensis Leaf Water, Aloe Ferox Leaf Extract, Aloe Ferox Leaf Juice and Aloe Leaf Juice Extract. Int J Toxicol 26 (Suppl 2): 1 – 50 doi:10.1080/10915810701351186. PMID 17613130.

3].H. Wayne Richardson " Copper Compounds" in ullmann's Encyclopedia of Industrial Chemistry, 2002.

4].P.P.N. Vijay Kumar, U. Shameem, Pratap Kollu, R.L. Kalyani "Green synthesized of characterization of CuO nano particles using Aloe Vera Extract and their Antimicrobial activity", BioNanoSci. DOI 10.1007/s12668-015-0171-z,2015.