ANTI FUNGAL ACTIVITY OF SURFACE MODIFIED Mn^{2+} DOPED ZnO NANOPARTICLES

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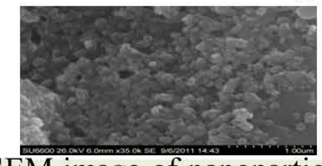
Abstract

This research has focused on determining the antifungal of activity of Mn^{2+} doped ZnO nanoparticles. The Mn^{2+}-ZnO nanoparticles coated with PEG was selected for the application as PEG is a biocompatible material which enhances the cell internalization of nanoparticles.[1] The Mn^{2+}-ZnO dispersed in PEG was synthesized by a modified version of an existing procedure which can be categorized as method of co precipitation. The nanoparticles were characterized by FT-IR spectroscopy, presence of Mn^{2+} and Zn^{2+} was determined by atomic spectroscopy (AAS) and the scanning electron microscopic image (SEM) was taken. Anti fungal activity was qualitatively determined by the plate method and the quantification carried out by the flask method.

A fresco at "Dambulla" with fungal growth



SEM image of nanoparticles

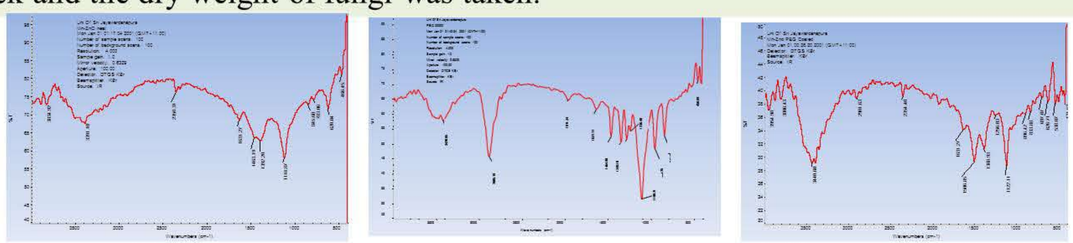
The synthesis apparatus of nanoparticles

Methodology

The Mn^{2+}-ZnO nanoparticles insitu coated with PEG was synthesized by a modified version of an existing procedure. The synthesis was carried out by using $ZnSO_4.7H_2O$, $MnSO_4.H_2O$, KOH and PEG 20000 as the precursor chemicals. The precipitate of $Zn(OH)_2$-Mn^{2+} was heated in an oven for one hour to obtain Mn^{2+} doped ZnO nanoparticles. Then they were characterized using FT-IR spectroscopy, SEM images were taken and the ratio of Mn^{2+} and Zn^{2+} was determined by AAS. Under the plate method The negative control (Potatoes dextrose agar-PDA) was prepared according to the standard procedure. Test sample was prepared by mixing nanoparticle dispersed medium with PDA.

The positive control was prepared by preparing the PDA medium in a Yellow Ag nano particles solution. The negative control of the positive control was done by preparing PDA medium with $NaBH_4$, Tri Sodium citrate, SDS and distilled water at a ratio of 6:6:2:1. Each medium was poured to Petri plates and the fungal colonies were sub cultured in to those plates. They were kept at room temperature. Observations were taken after four days. The flask method was carried out for the quantitative analysis. All media were prepared as explained above, but without adding agar. At sterilized conditions one weak old fungus on PDA plate was cut into similar size pieces by using the cork borer. Then same number of fungi pieces were added to each flask. The flasks were shook for one week and the dry weight of fungi was taken.

IR spectra



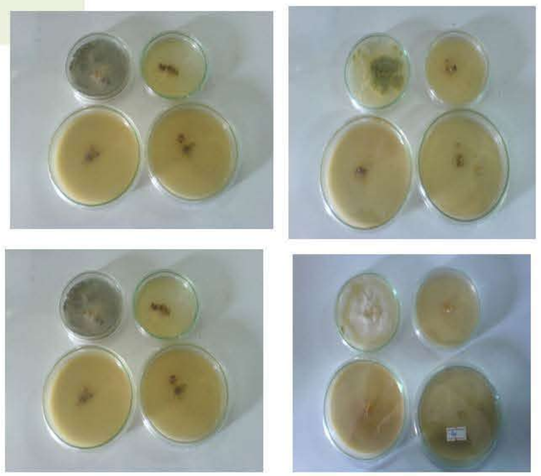
PEG | Neat Mn^{2+} --ZnO | PEG coated Mn^{2+} --ZnO

Introduction

Fungi are eukaryotic organisms which are widely spread on substrates which provide the required growing conditions. Such instances can be harmful and hence destroying them is considered as essential. The fresco fungi is such circumstance which is a great threat to the frescos and the existing methods to destroy fungi are impractical as they cause damage to the frescos too. The experiment was done by using Mn^{2+}-ZnO nanoparticles coated with PEG to eleven fungi genera, which caused damage to "Dambulla" frescos.

Results and discussion

The nanoparticles were well dispersed in the PEG medium. The nanoparticles were functionalized by FT-IR spectroscopy. Scanning electronic microscopic image was taken and the average particle size was 80 nm. The ratio Mn^{2+}:Zn^{2+} was determined by atomic absorption spectroscopy and it was 1:68. So the Mn^{2+}-ZnO nanoparticles can be abbreviated as $Mn_{0.01}Zn_{99.9}O$ according to the formula $Mn_xZn_{1-x}O$, where x is 0.01. PEG contain ether (C-O-C) group which the (C-O) bond stretching is expected to be appeared in the region of 1300-1000 cm^{-1}.[2] This is the main peak that has to be consider of as oxygen at ether bond donate the lone pair electrons to the metal ions in the coating process. It is clear that PEG has coated to nanoparticles by comparing the three IR spectra given below. A peak around 460 cm^{-1} corresponds to Zn-O bond stretching and a peak around 620.04 cm^{-1} indicates the presence of Mn-O bond stretching.[2] All the IR spectra include those peaks. So that observation proves that Mn^{2+} ions have doped to ZnO nanoparticles. The Mn^{2+}-ZnO nanoparticles coated with PEG was subjected to different fungi species of genera *Aspegillus, fusarium,* and *penicillium.*



Effect was fungicidal

Effect was fungistatic

*The concentration for a 100% , inhibition (*penicillium sp.* =0.3895 % (w/v)) was determined at the quantification.

References

1.Gupta,K.,Ajay, Curtis, A., (2002),*Centre for Cell Engineering,* **4,** 101-102

2.Gao, F., Lewis, R.A.,Wang, X.L., and Dou, S.X.,(2002), *Far-infrared reflection and transmission of* $La_{1-x}Ca_xMnO_3$, **347**, 314-318.