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Biosynthesis of silver nanoparticles using *Piper nigrum* and its application in the photocatalytic degradation

D. Latha[a], S. Munusamy[a], A. Padmanaban[a], G. Gnamoorthy[a], S. Sampurnam[a], C. Arul Vasu[b] and V. Narayanan[a]*

[a]Department of Inorganic Chemistry, [b]Department of Zoology,
University of Madras, Guindy Campus, Chennai-600 025, India

E-mail: vnnara@yahoo.co.in

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Stable silver nanoparticles (AgNPs) were synthesized from the leaf extract of *Piper nigrum*. It is a simple and environmentally benign method. The successful formation of AgNPs was characterized by UV-Visible spectroscopy (UV-Vis) at 447 nm and Scanning electron microscope (SEM) studies showed that the synthesized stable AgNPs was spherical in nature. The synthesized AgNPs has exhibited good photo catalytic properties in the degradation of dye (methyl orange).

Keywords: *Piper nigrum*, leaf extract, AgNPs, photocatalytic degradation, methyl orange.

Introduction

Number of methods are existing to synthesis of silver nanoparticles, like as thermal decomposition[1], electrochemical, microwave assisted process and green chemistry[2]. Moreover, plant-mediated AgNPs are favored due to its low-cost, eco-friendly method. Now synthesis of AgNPs using *Piper nigrum* it belongs to Piperaceae family. Methyl orange is an organic dye it is the reason for environmental pollution and it creates health problem to living organisms. In this study synthesis of AgNPs from *Piper nigrum* and its photocatalytic properties of AgNPs in dye degradation (methyl orange).

Materials and methods:

Synthesis of AgNPs:

The dried leaves of *Piper nigrum* ground into coarse powder and it was taken in a beaker containing DD water, digest then filter it. To synthesis AgNPs, by the addition of 1 mL of aqueous leaf extract with 15 mL of $AgNO_3$ solution in drop wise manner.

Characterization:

UV-Vis spectrophotometer was carried out on a Perkin-Elmer Lamda-45 spectrophotometer. Scanning electron microscopic (SEM) measurements were done using a Hitachi microscope-3400.

Photocatalytic degradation of methyl orange:

A suspension was prepared by the addition of AgNPs into 50 ml of methyl orange solution. Later, the suspension was allowed to stir continuously. Photocatalytic reaction was monitored by using a UV-Visible spectrophotometer.

Results and discussion

Contact time of AgNPs:

UV-Vis spectrophotometer analysis is used to confirm the formation of silver nanoparticles (AgNPs). The reduction of Ag^+ ions into AgNPs was monitored in the range of 300–700 nm. After 25 min the pale yellow colour of the mixture starts to change yellowish-brown color and SPR peak appeared at 447 nm due to the formation of AgNPs (Fig. 1). The intensity

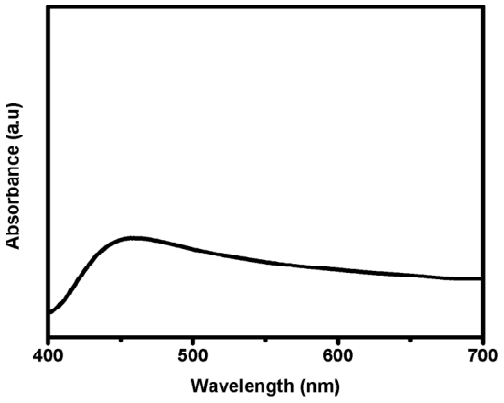

Fig. 1. UV-Vis spectral analysis of AgNPs.

of the SPR peak increased with increase in reaction time up to 60 min[3]. The size and morphology of synthesised stable AgNPs were almost spherical (Fig. 2).

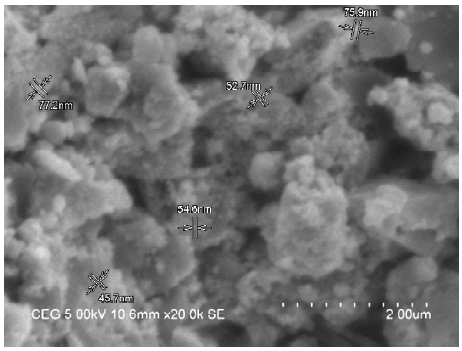

Fig. 2. SEM images of AgNPs.

Photocatalytic degradation of methyl orange:

Photocatalytic activity of AgNPs by the degradation of methyl orange dye as a substrate in the presence of light. The strong absorption band of methyl orange was found to be 462 nm as shown in Fig. 3. Degradation of methyl orange was monitored by decrease in peak intensity within 4 h of incubation time[4].

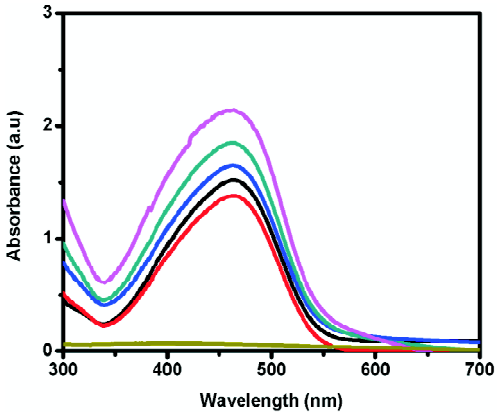

Fig. 3. UV-Vis absorption spectra for the degradation of methyl orange.

Conclusion

To conclude, synthesized stable AgNPs from *Piper nigrum* were found to be effective in degrading methyl orange dye in the presence of light illumination and it also act as a environmental bioremediation.

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