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Plant Mediated Synthesis of CdS Nanoparticles: Their Characterization and Application for Photocatalytic Degradation of Toxic Organic Dye

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ABSTRACT

In this work, an environmentally friendly and cheap method for the synthesis of CdS nanoparticles for the first time using an extract of *Dicliptera Roxburghiana* is presented. The present method is found to be reproducible and rapid. Structural analysis is carried out by UV-visible, FTIR, XRD, EDX, SEM, and TEM. XRD and TEM analysis revealed that the nanoparticles have spherical shape and size in the range of 2.5-8nm. FTIR studies showed the presence of functional groups which belong to the phytochemicals of plant extract that surround the nanoparticle preventing them from agglomeration. Thus the prepared CdS NPs exhibit excellent stability even after 2 months. The optical band gap was calculated using Tauc Plot i.e. 3.31 eV. Their activity as photocatalysts against an aqueous solution of methylene blue degradation under solar irradiation in a comparative manner is also reported and the particle has a % degradation of 87.12% in just 120 minutes under solar light irradiation.

1. Introduction

Nanotechnology is the study and application of particles having a size of about 1-100 nm (nanoparticle) and it is one of the emerging fields of material science in recent years and it is being used in almost every aspect of daily life. Nanoparticles are the substance having the size in between 1-100 nm so they are having a very small size also they have a high surface to area ratio [1]. It is, for this reason, they are nowadays the most important materials having distinguished physical and chemical properties. A variety of nanoparticles either have been synthesized and are in use for several purposes but semiconductor nanoparticles are of vital interest [2-6]
In the past few years semiconductors substances in nanocrystalline forms and the methods to synthesize those NPs, have gained the enormous interest of researchers because of their incomparable and distinctive spectroscopic and optical properties [7] and their applications in the remediation of the environment. Semiconductor nanoparticles can be used as sensing and inactivating environmental hazardous gas as well as they can be used for the treatment of polluted water [8-13]. Several semiconductor nanoparticles such as CdS, CdSe, ZnO, ZnSe, and CuO can be prepared by different bottom-up approach fabrication techniques [13-17] but among them, CdS-NPs are most extensively studied due to their distinctive physical and chemical properties. Cadmium Sulfide has a wide bandgap and its bandgap energy is 2.42 eV [18]. CdS nanoparticles are found to have high bandgap energy as compared to bulk due to the high surface area to volume ratio. The groups II-IV (chalcogenides), CdS semiconductor nanoparticles are highly sensitive towards the detection of visible rays since it's the sample photoconductor in most optical-electronic devices [19]. Increasing the efficiency of solar cells and also being used in various biological uses [20]. CdS nanoparticles as electrocatalyst in water splitting for the evaluation of H_2 and O_2 gases and also have a major part in water purification. They can be used for diagnosing and treating cancer because of their enhanced fluorescence and optical properties. The CdS