URS 2022|UOJ
UNDERGRADUATE RESEARCH SYMPOSIUM 2022
PHYSICS SOCIETY
UNIVERSITY OF JAFFNA

Optical and Electronic properties of greener synthesized colloidal semiconducting CdS nanoparticles

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Abstract

The utilization of toxic chemicals for the synthesis of nanoparticles has limited its application in the field of nanotechnology. The use of natural precursors in the nanoparticle synthesis has opened new paths in the field of nanotechnology to overcome the above strategy. Semiconducting nanoparticles, such as CdS, ZnS and CdSe are prominent materials in optoelectronic applications due to their dimension and photostability. Among these materials CdS Nanoparticles are highly preferred due to their excellent thermal and chemical stability and tunable bandgap. Generally, CdS Nanoparticles can be synthesized by micro emulsion, ultrasonic irradiation, sol-gel, and photo-itching methods. However, these methods are not cost-effective and environmentally friendly. Therefore, there is a need to synthesize these colloidal nanoparticles using greener approach.

In this report, we report a green method for the synthesis of cadmium sulphide (CdS) nanoparticles and its optical and electronic properties. CdS nanoparticles were synthesized by natural resources, such as garlic, onion and tobacco. Garlic and Onion were used as the Sulfur source and tobacco was used as Cadmium source. Both onion and tobacco used in this work are grown in Jaffna peninsula, Sri Lanka. The UV-Vis-NIR spectroscope, X-ray diffractometry (XRD) techniques were used to characterize the CdS nanoparticles. Moreover, the current-voltage (I-V) characteristics of CdS thin films were also studied to unveil the electrical conduction of the synthesized CdS films.

Finally, the semiconducting property of both of these colloidal CdS Nanoparticles were compared by fabricating a colloidal thin film field effect transistor on a 100 nm SiO_2 coated Si substrate using Pt as source and drain electrodes. The channel length of the fabricated was 2 µm and widths is 2 mm. The electrical properties of FETs were studied using computer interfaced source measure unit. The non-linearity in the I-V curves is observed in all the colloidal thin film FETs. This confirmed that the greener synthesized CdS colloidal nanoparticles are semiconducting and hence, they could be used for several optoelectronic applications.

Keywords: CdS; Green synthesis; Conductivity; Semiconductor; Tobacco; Garlic; Onion