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Optical Limiting in Gelatin Stabilized Cu-PVP Nanocomposite Colloidal Suspension

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Abstract. This article illustrates investigations on optical limiting properties of Cu-PVP nanocomposite colloidal suspension. Gelatin stabilized Cu nanoparticles have been synthesized using chemical reduction method and thin films in PVP matrix have been obtained using spin coating technique. Thin films have been characterized by X-ray diffraction (XRD), Ultraviolet-visible (UV-vis) spectroscopy, etc. for structural and linear optical studies. Optical limiting properties of Colloidal Cu-PVP nanocomposites have been investigated at 808 nm diode CW laser. Minimum optical limiting threshold was found for GCu3-PVP nanocomposites sample. The strong optical limiting is thermal in origin as CW laser is used and effects are attributed to thermal lensing effect.

Keywords: Cu nanoparticles, Cu-PVP nanocomposite, optical limiting.

INTRODUCTION

Metal nanoparticles have obtained tremendous interests because of the ease with which they can be synthesized and modified chemically [1]. Colloidal metal nanoparticles have been known since the end of the middle ages. Interest in copper nanoparticles (Cu NPs) arises from the useful properties of this metal such as the good thermal and electrical conductivity at a cost much less than silver and gold. This leads to potential application in cooling fluids for electronic systems and conductive inks [2]. Cu NPs are also widely used as catalysts for various reactions including water-gas shift and gas detoxification reactions, and as electrocatalysts in solid oxide fuel cells [3, 4]. On the other hand, due to their good biocompatibility and surface-enhanced Raman scattering (SERS) properties, Cu NPs may have potential applications as nanoprobes in medical diagnosis and biological analysis [5]. Due to surface plasmon resonance (SPR), Cu NPs exhibit enhanced nonlinear optical properties (NLO), which could result in many applications in optical devices and NLO materials, such as optical switches or photochromic glasses [6].

In this study, we have synthesized Cu NPs in colloidal form stabilized by gelatin. Copper colloids stabilized by gelatin having a stability upto six months were mixed with polyvinyl pyrrolidone (PVP) and thin film nanocomposites were obtained by the spin coating technique. Cu NPs and Cu-PVP thin films were characterized by various techniques for structural, optical and morphological studies. Optical limiting properties of Cu-PVP nano colloids have also been investigated using diode laser at 808 nm. The results and discussions have been presented here.

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