

Determination of the optical constants and optical limiting of doped malachite green thin films by the spray method

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ABSTRACT

The spray method technique has been successfully used to deposit highly uniform and good adhesion malachite green (MG) thin films. The optical constants of the doping thin films were obtained from the analysis of the experimental recorded transmittance and absorption spectral data over the wavelengths range 300-1000 nm. The values of some important parameters (refractive index n , the dispersion energy E_d the oscillation energy E_o and energy band gaps E_g) have been determined by reflection spectra. The third-order nonlinear optical properties, $\chi^{(3)}$, of MG thin films film are evaluated from changes of index of refraction using Millers rule. Optical limiting have been observed and studied by means of single beam transmission technique, using a continuous-wave (cw) visible solid state laser beam with a wavelength of 532 nm and 30 mWatt output power.

Key words : Malachite green, Optical constants, Single oscillator, Optical limiting.

INTRODUCTION

A material is said to be a thin film when it is built up as a thin layer on a substrate by controlled condensation of the individual atomic, molecular or ionic species either directly by a physical process or through a chemical and/or electrochemical reaction. Otherwise, it is a thick film. There are various techniques of producing thin films for scientific application, which include: physical vapour deposition (PVD) technique, chemical vapour deposition (CVD), electrochemical deposition (ECD), hybrid technique, and chemical bath deposition (CBD) technique [1,2].

Thin films occupy a prominent place in basic research and solid state technology. The use of thin film semiconductors has attracted much interest in an expanding variety of applications in various electronic and optoelectronic devices due to their low production cost. Thin film can be made of multi-component, alloy/compound or multi-layers coatings on the substrates of different shapes and sizes [3,4].

In this paper, we present the procedure for preparing different material, undoped (pure MG), NaBH_4 -doped MG and I-doped MG thin films using spray method technique on glass substrates. The optical constants and band gaps are determined by optical characterization method. Optical limiting have been observed and studied by means of single beam transmission technique, using a continuous-wave (cw) visible solid state laser beam with a wavelength of 532 nm and 30 mWatt output power.

MATERIALS AND METHODS

Malachite green (MG) was supplied from Aldrich Company with purity 96% , with molecular weight 927.03, has been selected for our experiments as shown in Fig. 1. Malachite green is a basic dye. Basic dyes are salts of the