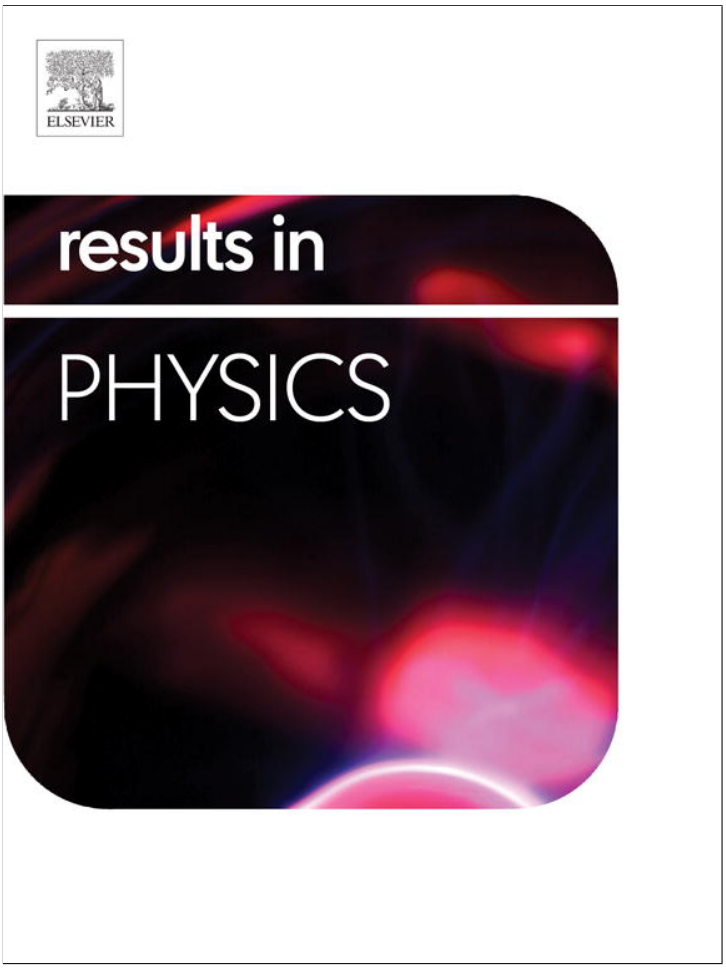

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Thermal lens and all optical switching of new organometallic compound doped polyacrylamide gel

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ABSTRACT

In this work thermal lens spectrometry (TLS) is applied to investigate the thermo-optical properties of new organometallic compound containing azomethine group, Dichloro bis [2-(2-hydroxybenzylideneamino)-5-methylphenyl] telluride platinum(II), doped polyacrylamide gel using transistor-transistor logic (TTL) modulated cw 532 nm laser beam as an excitation beam modulated at 10 Hz frequency and probe beam wavelength 635 nm at 14 mW. The technique is applied to determine the thermal diffusivities, ds/dT and the linear thermal expansion coefficient of the sample. All-optical switching effects with low background and high stability are demonstrated.

Introduction

It is well known that dye doped polymer under irradiation of a linear pump beam causes photo induced birefringence owing to photochemical reactions. Dye doped polymer has generated a wide interest in recent years because it offers possibilities for the application in optical storage, optical communication and information processing, especially all-optical modulators [1–8]. All-optical switching using dye-doped polymer is certainly one of the most interesting topics at present [9–12]. However, many problems in the optical switching experiments [13–19] based on polymers still need to be tackled, such as slow response (millisecond order of magnitude), large background, low stability, extinction ratio of the switching signal, etc. Thermal lens spectrometry (TLS) is one of the sensitive photothermal techniques upon temperature gradient which is due to absorption of electromagnetic radiation and nonradiative relaxation of the excited molecules. In the TLS experiment the excitation laser must have Gaussian profile, so when a sample absorbs the beam with Gaussian distributed intensity the temperature distribution has a radial dependence. The temperature gradient causes refractive index gradient which behaves like a converging or diverging lens depending on whether the change rate of refractive index with respect to temperature, is positive or negative [20–22]. The high sensitivity character of this technique makes it very appropriate for measuring the thermal diffusivity of samples which relies on physical changes that happen in the sample.

In this work thermal lens spectrometry is applied to evaluate the thermo-optic coefficient of Dichloro bis [2-(2-hydroxybenzylideneamino)-5-methylphenyl] telluride platinum(II): polyacrylamide gel. In TL experimental set up a transistor-transistor logic (TTL) modulated cw laser of wavelength 532 nm and cw laser at 635 nm wavelength were used as the excitation source and the probe beam, respectively. A simple all-optical switch is demonstrated in the dye: polyacrylamide gel. The all-optical switching effect has been studied at 14 mW power and 0.55 mM concentration of the sample.

Preparation of materials

The sample of new organometallic compound: polyacrylamide gel was prepared from Dichloro bis [2-(2-hydroxybenzylideneamino)-5-methylphenyl] telluride platinum(II) and polyacrylamide (average Mw = 10,000 g/mol, Sigma–Aldrich) by dissolving (1 g, 2.2 mmol/L) the dye in 50 mL distilled water, and (0.1 g, 1.4 mmol/L) polyacrylamide dissolved in 50 mL distilled water, then the dye solution and the polyacrylamide solution were mixed. The mixture was stirred at room temperature for 50 min to inter all dye molecules within polymer chains, then the solution was filtered through a 0.2 μm syringe filter. After that, the solution of dye: polyacrylamide was mixed, heated (up to 85 °C) and stirred for 1 h, then the mixture was cooled to room temperature to obtain a dye: polyacrylamide gel. The chemical structure of Dichloro bis [2-(2-hydroxybenzylideneamino)-5-methylphenyl] telluride platinum(II) is shown in Fig. 1.

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