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Sudan IV dye based poly(alkyloxymethacrylate) films for optical data storage

Qusay Mohammed Ali [a], P.K. Palanisamy [a,*], S. Manickasundaram [b], P. Kannan [b]

[a] *Centre for Laser Technology, Department of Physics, Anna University, Chennai 600 025, India*
[b] *Department of Chemistry, Anna University, Chennai 600 025, India*

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Abstract

The polymer poly{1-[2′-methyl-4′-(2″-methylphenylazo) phenylazo]-2-(*m*-methacryloyloxyoctyloxy}naphthalene, where $m = 6$, 8, 10, is synthesized by free radical addition polymerization method for holographic optical data storage. Characterization of the polymers is done by formation of the holographic grating. A study of the dependence of diffraction efficiency of the grating formed on various parameters is presented. Surface relief gratings on these polymer films are created upon exposure to argon ion laser beams at 514.5 nm without any subsequent processing steps. The surface structure of the relief gratings has been investigated by atomic force microscopy. The depth of surface relief in a typical case is found to be around 40 nm.

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Keywords: Photopolymers; Optical data storage; Surface relief grating

1. Introduction

In the past decade, optical recording media had become a subject of extensive scientific and industrial interest. Good stability for optical storage media is as important as high optical sensitivity, high storage densities, and short access time [1]. Various approaches for achieving higher storage densities as well as high access rates have been proposed. These focus on optical means of information storage, with holographic recording [2], photon echo [3], and more recently two-photon or three photon based [4–6] three-dimensional (3D) memories [7] representing specific approaches. 3D optical memories are sought as they have potentially much higher capacity than the current two-dimensional devices.

It is known that polymers containing azo dye have been proven to be suitable materials for optical storage and electro-optic modulators [8,9]. It has been found that surface relief gratings can be formed in polymers containing azobenzene through irradiation with light [10,11]. The gratings are very stable when kept below the glass transition temperature of the polymers. Numerous research groups have investigated the formation of SRG, and several mechanisms have been proposed for the SRG formation process [12–15]. It is generally accepted, however, that the photoinduced trans $\Longleftrightarrow$ cis isomerization of azochromophores in the azopolymers is a prerequisite to the formation of SRG [16]. Therefore, a large number of azo containing polymers with varying chemical composition have been synthesized over the recent years and studied for the photofabrication of SRG [17–20].

The methacrylate polymer systems in particular have been studied in great detail by Natansohn's group [21–23]. The attractive features of these systems are the high birefringence obtainable due to polarized laser beam

* Corresponding author. Tel./fax: +91 44 2220 3160.
E-mail addresses: profpkpannauniv@yahoo.co.in, pkp@annauniv.edu (P.K. Palanisamy).

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