J Mater Sci: Mater Electron (2011) 22:25–34
DOI 10.1007/s10854-010-0077-z

Holographic grating studies in pendant xanthene dyes containing poly(alkyloxymethacrylate)s

S. Manickasundaram · P. Kannan · R. Kumaran · R. Velu · P. Ramamurthy · Q. M. A. Hassan · P. K. Palanisamy · S. Senthil · S. Sriman Narayanan

Received: 28 October 2009 / Accepted: 2 February 2010 / Published online: 13 February 2010

Abstract A series of xanthene dyes based poly(alkyloxymethacrylate)s were synthesized with even number of side-chain methylene spacers by free radical addition polymerization method for holographic grating studies. Chemical structure of monomers and polymers were confirmed by FTIR and ^{1}H-NMR spectroscopy. Thermal property was investigated by TGA and DSC. Lengthy spacers favor improved optical quality film formation than shorter spacer length containing polymers; however, thermal stability and Tm decreased. Absorption and emission spectra have been studied in different polar solvents. UV–vis absorption maxima were broad and red-shifted with increasing spacer length. Life-time decay analysis exhibited double exponential decay. Polymer films were tested for holographic grating formation and their diffraction efficiency compared. Photo bleaching mechanism of polymer films was disclosed by measuring electrochemical potential value.

S. Manickasundaram · P. Kannan (✉)
Department of Chemistry, Anna University,
Chennai 600025, India
e-mail: pakannan@annauniv.edu

R. Kumaran · R. Velu · P. Ramamurthy
National Center for Ultra Fast Processes, University of Madras,
Taramani, Chennai 600113, India

Q. M. A. Hassan · P. K. Palanisamy
Centre for Laser Technology, Department of Physics,
Anna University, Chennai 600025, India

S. Senthil · S. Sriman Narayanan
Department of Analytical Chemistry, University of Madras,
Chennai 600025, India

1 Introduction

Technological advancement in organic photo responsive materials is achieved via covalently incorporated photosensitive dyes as pendant group in polymers [1]. Absorption wavelength and bandwidth of dye in side chain polymers determine the color and optoelectronic device applications. One of the most versatile organic photosensitive compounds is xanthene dye, ascribable to long phosphorescence life-time [2], strong absorption wavelength to lasers [3] photo initiator [4], photo sensitizer [5] and laser dye. Observation of absorbance and fluorescence behavior of these dyes in functionalised polymer system serves as a useful tool to study electronic excitation and energy migration in different solvents. Insertion of flexible groups in side chain polymers is effectively utilized in technological domain such as development of membranes [6, 7] liquid crystalline materials [8, 9] new solid ionic conducting materials [10, 11] or materials for information storage [12–15].

Wide variety of polymer backbones have been used for grafting photosensitive dyes as a pendant group, among them, the most promising one is poly(methyl methacrylate), because PMMA backbone not only provide high optical transparency over a broad frequency range but also possess high glass transition temperature, low dielectric constant and good processability [16]. Side chain photo responsive group containing methacrylate backbone has been considered as convenient and practical tool for optical applications [17–19]. Currently, an intensive research effort is being attempted to use holographic technique for optical information storage [20]. Drawback of storage materials described so far requires optically homogeneous monodomain films. This becomes increasingly complex as the size of storage device increases. Large film area of