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Spatial light modulation characteristics of reverse saturable absorber

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Abstract. Construction of a spatial light modulator (SLM) using reverse saturable absorber molecules is suggested. The SLM characteristics are derived using a recently proposed steady-state kinetic analysis. Results are presented for the rhodamine 6G dye molecules.

Keywords. Lasers; spatial light modulators; reverse saturable absorbers; excited state absorption; optical computers.

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1. Introduction

In principle optical-processing and computing systems based on Fourier-transform type operations offer processing speeds approaching the velocity of light. However, the speeds of these systems are severely limited by the response times of the input and output transducers. To fully utilize the potential of all optical processing and computing systems, real-time reusable two-dimensional input transducers or spatial light modulators are required for data presentation at both input and Fourier planes. The SLMs can also be used for image amplification, time/space transformation, scratch pad memory, programmable detector masking and page composition for hologarphic memories. Hence, in the past decade the list of SLMs under development or in production has expanded considerably. Recently it has been shown that the organic materials which have been playing very important role in the field of Q-switching and mode-locking of lasers (Shapiro 1977) and second-harmonic generation (Chemla and Zyss 1987) may provide the ideal medium needed for the optical hardware used in optical information processing and computing systems. Hence, the phenomena of optical modulation, (Kirkby and Bennion 1986) optical bistability (Orenstein *et al* 1987) and optical phase conjugation (Kramer 1986) in organic materials have also been studied. A detailed study of the possibility of constructing a molecular SLM using a nonlinear absorber has been reported recently (Speiser and Dantsker 1989). Using a steady-state kinetic analysis it has been shown that a probe light can be modulated by propagating through a medium excited by another light.

The nonlinear absorbers having excited state absorption cross sections larger than the ground state absorption cross section known as reverse saturable absorbers (RSA), have been receiving attention recently because of their usefulness in the process of mode locking of lasers (Harter *et al* 1985). Organic dye molecules such as Rhodamine 6G exhibit RSA characteristics over a certain range of wavelengths (Harter *et al* 1984).