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Theoretical research on the random lasing from two-dimensional anisotropic media consisted of liquid crystal and mixed dye

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Abstract The random lasing action in two-dimensional random media is investigated by simultaneously solving Maxwell's equations and rate equations of electronic population. The random media are composed of scattering liquid crystal (LC) particles and mixed dye materials. The anisotropic scattering LC particles are arranged to be disordered in the spatial orientation of their optical axes. A parameter $K = n_o/n_e \leq 1$ which denotes the ratio of the refractive indexes at two principal axes is defined to characterize the degree of the orientational disorder. The number of the lasing modes increases quickly with the decreasing of ratio K. In addition, the simulation of the external modulation of dielectric constant is studied. Results indicate that the spectrum intensity would be enhanced; whilst the frequencies of the lasing modes do not change significantly.

Keywords Liquid crystal · Anisotropic · Nonlinear optics · Laser physics

1 Introduction

Random lasers are based on the combination between the disordered medium that confines light waves and the gain medium. Random lasing in disordered media is of significance for both fundamental research and technological applications. In the past decades, great research efforts have been achieved in the field (Lawandy et al. 1994; Wiersma et al. 1995, 1997; Balachandran et al. 1997; Dice et al. 2005; Noginov et al. 1995; Zhang et al. 1995a,b; Wang et al. 1998; de Souza et al. 2006a,b; Sha et al. 1994, 1996; Vaveliuk et al. 2003; Zhang and Chu 1990; Veltri et al. 2011; Stark and Lubensky 1997; Soize 2004; Wiersma and Cavalieri 2002; Mujumdar et al. 2004; Gottardo et al. 2004; Liu et al. 2006;

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