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STIMULATED EMISSION IN ORGANIC FILMS FOR LONGITUDINAL PULSED PUMPING [1]

In this paper the generation of Rhodamine 800 (Rh 800) in ethanol and also mixtures of Pirrometen 597 and Rh 800 in transversal pumping and longitudinal types is investigated. TGF PMMA, Rh 800 solvents with copolymer PMMA – IBMA films generation characteristics are obtained. Research was conducted at exaltation by the pulse laser (wavelength of excitement is 532 nm, duration of an impulse is 10 ns, pumping power density is 13 MW/cm^2). Films doped with the dye were created by a watering method (concentration of days = 5 × 10 - 4 moll/l). Thickness of films was measured using the optical profilometer KLA – Tencor MicroXam 100 and was obtained 5.8 microns.

Keywords: *longitudinal pumping, transversal pumping*

Introduction

Today the modern scientific investigation in the field of organic electronics and laser systems focus on the development of new organic materials which can be used as the active laser media. At the beginning scientists focused their attention on liquid organic active laser media. Later the most convenient for application solid – state active media as the alternative to liquid media but having the same characteristics were developed. Nowadays thin-film active media are of interest as they can be introduced in various electronic devices used in medicine, spectroscopy, etc. [1].

The organic thin film lasers are considered as the active laser media in medical devices as they have the property of wavelength tuning in rather a wide spectrum range. In this study organic dye Rhodamine 800 is considered as the substance for the laser active medium taking into account the fact that the wavelength of generation of this dye (720-790 nm) is in the transparency window of biological tissues (700 – 1000 nm). It allows the scientists to use these lasers in such area of medicine as multiphoton confocal microscopy. Its technique is based on the capability to receive detailed three - dimensional images of biological objects and tissues due to change of focusing of laser radiation and a larger depth of radiation penetration on the considered wavelength [2].

There are some problems in the field of thin film lasers research, connected with the loss of output radiation. Firstly it is technologically very difficult to receive high quality sides of organic films (it is necessary for generation development along a film) since the material structure is amorphous. Secondly it is important to select a resonator as it is one of the basic elements of a laser system [3].

In this connection one of the problems is to choose a resonator. In this study we choose a longitudinal pumping with an external resonator. The principal difference of this setup consists in its simplicity, capability of output emission from a film with small losses, the possibility to vary resonator parameters. The disadvantage of a longitudinal setup is the need to use dielectric (or holographic) mirrors in a resonator. So, the input mirrors must be the most transparent for pumping radiation, and opaque for generation, while an output mirror must be opaque for pumping radiation and partially transparent for lasing radiation [4, 5].

Experimental

In these study thin films of Rhodamine 800 in polymethyl methacrylate (PMMA) and in copolymer polymethyl methacrylate + isobutyl methacrylate were created by a watering method (PMMA-IBMA) (0, 02 g of polymer on 1 ml of solution). Dye concentration in solvent mixture (tetrahydrofuran) with polymer was 10-4 mol/l. The thickness of films was measured using the optical KLA-Tencor MicroXam 100 profilometer, and made 10 microns. Absorption spectra and fluorescence of films were investigated in CM2203 spectrofluorometer. The absorption spectrum maximum for a film in PMMA is on wavelength λ = 685 nm, and for a film in PMMA + IBMA on λ = 680 nm, a fluorescence wavelength maximum – on 720 and 713 nm respectively (Figure 1). Despite high dye concentration in a film, the optical density at excitation wavelength (532 nm) makes only 0.28, hence efficient Rhodamine 800 absorption at pumping wavelength is low. Under such conditions a considerable part of radiation passes through a film. Pumping area was a 20 mm2 (circle). Lasing spectra are received under power density of

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pumping of 65 MW/cm^2. The lasing efficiency in films was about 0, 6 %, a wavelength of generation was 786 nm.

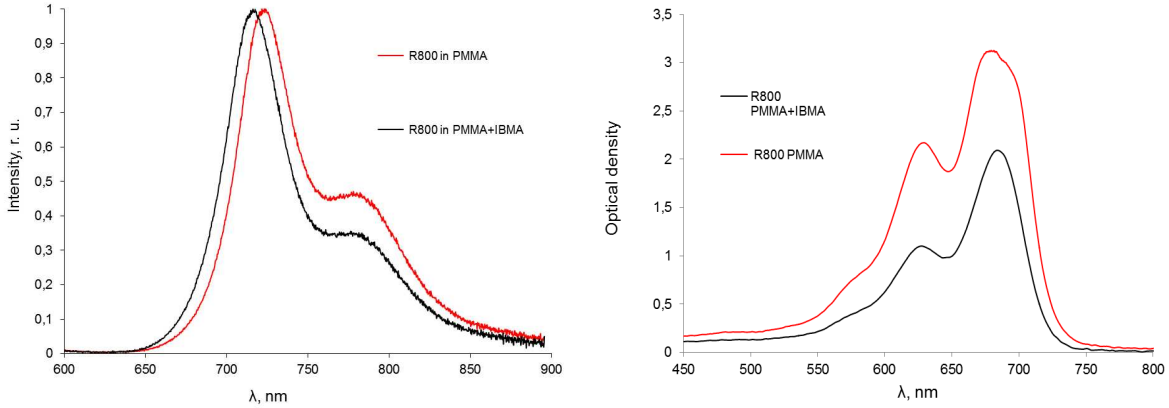

Fig.1. Absorption and fluorescence spectra in the film

Results and discussions

Thus it was established that in a film the coupled waveguide resonator is formed which radiation leaves film end faces. Formation of such resonator is harmful as it leads to decrease in efficiency of generation in the longitudinal resonator. However, decrease of the area of excitation (introduction of a diaphragm, focusing) reduces undesirable losses.

Conclusion

Further work is planned to investigate the dependence of lasing efficiency versus film thickness and excitation area.

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ВЫНУЖДЕННОЕ ИЗЛУЧЕНИЕ В ОРГАНИЧЕСКИХ ПЛЕНКАХ ПРИ ПРОДОЛЬНОЙ ИМПУЛЬСНОЙ НАКАЧКЕ

В работе проведено исследование генерации Родамина 800 в этаноле, а также смеси красителей Пиррометена 597 и Родамина 800 в поперечном и продольном варианте накачки. Сняты генерационные характеристики пленок, полученных из ТГФ раствора ПММА и Родамина 800 с сополимером ПММА-ИБМА. Исследования проводились при возбуждении импульсным лазером (длина волны возбуждения 532 нм, длительность импульса 10 нс, плотность мощности накачки 13 МВт/см^2). Пленки, допированные красителем создавались методом полива (Скрасителя = 5×10 -4 моль/л). Толщина пленок измерялась на оптическом профилометре KLA-Tencor MicroXam 100 и составила 5,8 мкм.

Ключевые слова: *Продольная накачка, поперечная накачка.*

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