New composite materials for optoelectronic applications

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ABSTRACT

The problem of obtaining low cost but efficient luminescent materials is still actually. Data concerning fabrication and luminescent properties of new composite materials on the base of thenoyltrifluoroacetone (TTA) of Europium(III) ($Eu(TTA)_3$) and chalcogenide glasses doped with rare earth ions and polymers are presented. The visible emission spectra of the composites on the base of $Eu(TTA)_3$ structured with phenantroline ($Eu(TTA)_3Phen$) and copolymer from styrene and butylmethacrylate (1:1)(SBMA) under the excitation with N_2-laser (λ=337 nm) contain sharp emission bands located at 354, 415, 580, 587, 590, 596, 611.4, 616.5, 621, 652, 690, 700, 713 nm. The nature of the observed emission bands and the possible mechanisms of the radiative electron transition in the investigated composite materials are discussed.

Keywords: Nanocomposites, polymers, rare earth ions, optical absorption, luminescence

1. INTRODUCTION

The development of new organic/inorganic nanostructured composite materials is very attractive for future implementation of new photonic and optoelectronic devices. Some general principles of nanotechnology and nanostructured materials, its properties and possible applications are presented in the review article [1]. Actually the definition of nanocomposite materials has broadened significantly and includes a large variety of systems and structures such as one-dimensional, two-dimensional (metal oxides, metal phosphates, chalcogenides), three-dimensional and amorphous materials. Now the main efforts are focused on the ability to obtain control of the nanoscale structures with the requested physical and optical characteristics trough innovational synthesizing approaches. It was shown that the properties of nanocomposite materials depend not only of the properties of their individual host components but also on their morphology of the final product and interface characteristics.

In the recent years the luminescent composites based on lanthanide complexes have attracted much attention due to scientific interests as well as for its wide variety of application in photonics and optoelectronics: planar optical amplifiers, solar cells, light emitting diodes, gas selective sensors, photonic devices, etc. [2,3]. It should be mentioned that for the rare-earth doped optical waveguide amplifiers of inorganic materials (silica and chalcogenide glasses) there are some limitations of doping due to the concentration quenching effects: for silica glasses the doping level is limited up to 0.1 mole percent [4]. This problem is easy solving by using for this purpose organic systems. The polymer matrices can be doped too much higher concentrations than silica glasses, using different lanthanide complexes. For this goal a new composite on the base of thenoyltrifluoroacetone of Europium(III) was used. In the paper the luminescent properties of new composite materials on the base of $Eu(TTA)_3{\cdot}H_2O$, $Eu(TTA)_3Phen$. Composite materials on the base of $Eu(TTA)_3$ and copolymer from styrene and butylmethacrylate (1:1) (SBMA) also was prepared and investigated.

2. EXPERIMENTAL

The method of preparation of compounds tris(2-thenoyltrifluoroacetonato) aquaeuropium(III)) ($Eu(TTA)_3){\cdot}H_2O$) and tris(2-thenoyltrifluoroacetonato)(monophenanthroline) europium(III) ($Eu(TTA)_3Phen$)) was used as it was described by authors [5-7]. The structures of the compounds $Eu(TTA)_3){\cdot}H_2O$ and $Eu(TTA)_3Phen$ is shown on the Fig.1a and 1b. The method of the interaction of europium nitrate with thenoyltrifluoroacetone in the presence of sodium hydroxide was

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