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Fabrication, characterization and electroluminescence studies of SrS: Ce^{3+} ACTFEL device

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ABSTRACT

The SrS: Ce^{3+} thin film active phosphor layer of different thickness based alternating current thin-film electroluminescent (ACTFEL) devices are fabricated by electron beam evaporation deposition (EBED) method. The morphology and chemical composition of the deposited films are investigated by field emission scanning electron microscopy (FESEM). The optical transmittance in visible range for the optimum film and optical band gap of SrS: Ce^{3+} film is described on the basis of Ce^{3+} doping concentration.

1. Introduction

In recent years, nanocrystalline semiconductor thin films have played an important role in research work due to their future applications in the diverse fields of science and technology. These kinds of films are used in various electronic devices because the optical, electrical and chemical properties of the material change significantly upon varying the grain size and thickness of the film [1]. Thus, it offers the possibility of materials enhancement device characteristics [2]. SrS: Ce is a promising phosphor material for blue and white alternating current thin-film electroluminescent (ACTFEL) devices [3]. The development of full-color ACTFEL flat-panel displays has motivated researchers to explore a variety of phosphor host/luminescent impurity combinations [4–6]. A simple ACTFEL device consists of a metal-insulator-semiconductor-insulator-metal (MISIM) structure deposited on a substrate, usually glass. The primary application of ACTFEL technology is as a thin display in the flat-panel display (FPD) industry, which is driven by the demand for portable displays [7]. The leading FPD technology is the liquid-crystal display (LCD) found in a number of applications, such as watches, calculators, laptop, computer monitors and hand-held electronic devices. SrS is a promising host material for thin film electroluminescent (TFEL) displays, and has been extensively studied as the blue component for multi- and full-color electroluminescence (EL) display panels [8].

The goal of the present study was to develop new sulfide processes for thin film phosphors for their use in ACTFEL devices and to study their effect on EL properties of the device. Sulfide materials were selected because the most successful phosphor materials used in ACTFEL devices have been sulfides [9]. In the present work, ACTFEL devices are fabricated using SrS: Ce^{3+} as the active emitting layer with different thicknesses (300 nm, 500 nm and 700 nm) on low temperature glass substrates.

2. Device fabrication

We have earlier reported that SrS thin films with 0.5 mol% of Ce^{3+} doping exhibit highest luminescence intensity [10]. Therefore, the SrS: Ce^{3+} (0.5 mol%) based ACTFEL devices with different active phosphor layer thickness (300 nm, 500 nm and 700 nm) were prepared at 250 °C by EBED techniques. In this technique, the long range distortion is witnessed which triggers loss of long range order in as-prepared thin films, but it can be controlled by controlling the physical conditions like temperature, pressure, etc. The SrS phosphor layers of different thickness were deposited on ITO coated glass substrates. The SrS: Ce^{3+} phosphor is sandwiched between zinc sulfide (ZnS) buffer layers. The zinc sulfide buffer layers each of thickness ~100 nm are also deposited at a temperature of 150 °C by EBED method. Aluminum (Al) served as the rear

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