UNIVERSITI TEKNOLOGI MARA

EFFECT OF SAMARIUM ON THE PHYSICAL, STRUCTURAL AND OPTICAL PROPERTIES OF BOROTELLURITE GLASS SYSTEM

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

A series of glasses with composition (70-x)TeO_2 + 20B_2O_3 + 10ZnO + xSm_2O_3, where $0.0 \leq x \leq 2.5$ mol % has been prepared with different concentration of samarium ions using melt-quenching method. The amorphous nature of the glass has been investigated through X-Ray Diffraction (XRD) and all glasses are found to be amorphous in nature. The physical, structural and optical properties are determined. The density of glass was found to increase steeply before it suddenly drop while the molar volume was found to decrease before it start to increase with respect to Sm^{3+} content. FTIR spectroscopy has been used in order to identify the structure of the glass system. From FTIR spectra, the absorption bands are found in the regions around 714-725 cm^{-1}, 839-855 cm^{-1}, 1215-1218 cm^{-1}, 1362-1367 cm^{-1}, 2993-3003 cm^{-1} and 3741-3748 cm^{-1} which correspond to the stretching vibration modes. The absorption spectra displayed three strong absorption peaks corresponding to the $^6H_{5/2} \rightarrow {}^4L_{13/2}$, $^6H_{5/2} \rightarrow {}^4M_{19/2}$ and $^6H_{5/2} \rightarrow {}^4I_{11/2}$ transitions respectively which located at 403 nm, 422 nm and 480 nm. Meanwhile, the emission spectra of Sm^{3+} doped borotellurite glass which correspond to the $^4G_{5/2} \rightarrow {}^6H_{5/2}$, $^4G_{5/2} \rightarrow {}^6H_{7/2}$, $^4G_{5/2} \rightarrow {}^6H_{9/2}$ and $^4G_{5/2} \rightarrow {}^6H_{11/2}$ transitions at 562 nm, 599 nm, 645 nm and 706 nm respectively were observed under the 480 nm excitation wavelength. The photoluminescence result reveal that 1.0 mol% of Sm^{3+} ions is found to be the optimum concentration as it shows the most intense emission spectra.

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CHAPTER ONE
INTRODUCTION

1.1 INTRODUCTION

In this chapter, the general information about this research will be explained in detail, which the research is about investigation on the physical, structural and optical properties of borotellurite glass with different percentage of dopants. In this chapter will notify the background of study, problem statement, research objectives, significance of study and also limitations of study.

1.2 BACKGROUND OF STUDY

Glasses are defined as inorganic product of fusion or amorphous solid material which has been cooled to a rigid condition without crystallization (Srisittipokakun et al., 2011). The interesting characteristics about the glass are it acquires many unique properties like transparent, hard, brittle, not corrode and has glass transition. Glasses are increasingly used as host material for solid state laser based on rare earth (RE) ions which provides the necessary information with regard to the lasing properties. Since the quantum efficiency of the emission transitions strongly depends on the structural modifications of the host matrices, the selection of the host material is important to obtain higher luminescence efficiency in the design of optical devices.

A great deal of study have been carried out over the past few decade on the optical behaviour of the RE doped various based glasses due to their excellent potential in technology and commercial applications. One of the suitable host for doping with RE element are believed to be tellurite glasses. Tellurite glasses have good characteristic features in mechanical stability, chemical durability (Fujita et al., 2002) and an excellent transparency in the far infrared region (Pavani et al., 2011), plus are non-hygroscopic in nature compared to other oxide glasses make they are responsible for their applications in optical devices, erasable recording materials, laser hosts and others (Azianty et al., 2012).