Structure and luminescence property of Eu^{2+},Dy^{3+}-doped SrO-MgO-SiO_2 glass

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Abstract. Eu^{2+}, Dy^{3+}-doped SrO-MgO-SiO_2 glass was firstly synthesized by sol-gel method, its structure features and optical properties have been investigated by X-ray diffraction and luminescence spectra. X-ray diffraction pattern indicates the amorphous structure of glass phase. According to luminescence spectra, Strong red emission which centered at 587nm which are attributed to the energy level transition of $5D_i(i=0,1)\rightarrow 7F_j(j=0\sim4)$from Eu^{2+}.

Introduction

With the development of the science and technology, the luminescent materials has attracted attention over the recent years[1-4]. The kinds of the luminescent materials have from polycrystalline to monocrystalline particale, thin-film, ceramic, glass and so on[5-9]. But the worse stability and comfection of crystals limited their further application. As the glass has the characters of homogeneous and transparent, and it can be mixed at higher concentration of doped luminescent ions, So many scientists have increased interest in glass, which has great potential for applications in optical information processing[10-12].

In this paper, Eu^{2+}, Dy^{3+}-doped SrO-MgO-SiO_2 glass was synthesized by sol-gel preparing process.and their structure and luminescent properties were also studied.

Expriment

Synthesis.Eu^{2+}, Dy^{3+}-doped SrO-MgO-SiO_2 glass was synthesized by sol-gel preparing process. $Mg(NO_3)_2{\cdot}6H_2O$, $Sr(NO_3)_2$ were dissolved to water; $Si(OC_2H_5)_4$ was dissolved to ethanol.The two kinds of solution above were mixed under stirring. Molar ratio of SrO: MgO: SiO_2: Eu_2O_3: Dy_2O_3 was 40: 20: 40: 0.1:0.2. When the solution was stirred for 0.5h, a mount of citric acid (CA) that was used as the chelating was added to the above solution, and subsequently pH was tuned to 1.0 by nitric acid. After stirring for 2h, the solution was aged for 24h at 80℃ to form gel in a water bath. The dried gel was sintered at a higher temperature at 1000℃ for 1h, with a heating rate of 5℃/min. All heat treatments were performed in an atmosphere of air.

Measurements. Fluorescence spectra was measured with a Hitachi F-7000 fluorescence spectrophotometer. Differential thermogravimetric analysis(DTG) and differential thermal analysis (DTA) of the powdered gel precursors was carried out on a HCT-2 microcomputer differential thermal Balance. X-ray diffraction (XRD) analysis was performed on a BDX3200 diffractometer using CuK_a radiation.

Results and discussion

DTA-TG analysis.

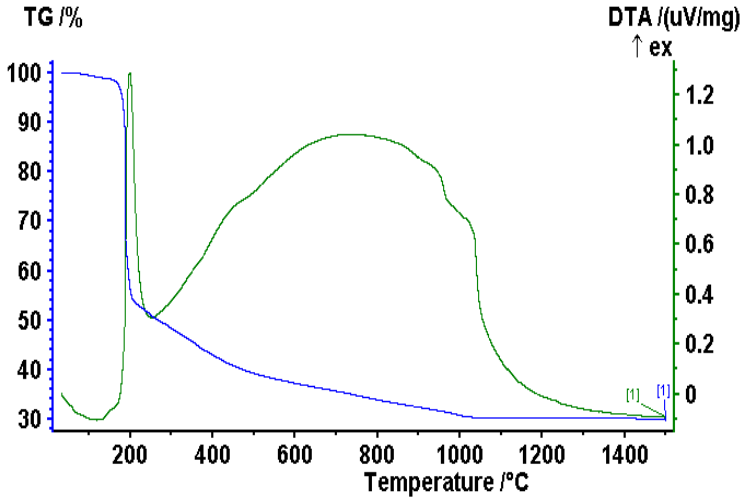

Fig.1 DTA-TG curves of the xerogel

Fig.1 shows the DTA-TG curves of xerogel compositing of 40SrO-20MgO-40SiO_2: 0.1Eu^{2+}, 0.2Dy^{3+}, which has been dried at 60℃ for 24 hours. TG curve indicates that the mainly weight loss appears between 150℃ and 1050℃, which is 68.23%. The first exothermic peak occurs at 180~200℃, accompanied by mass loss of 46.03%, which could be attributed to decomposing removal of citric acid in xerogel. The second endothermic peak near 260℃ accompanied by mass loss of 17.67%, which could be caused by decomposing removal of nitric acid in xerogel. The third exothermic peak from 500℃ to 1000℃, accompanied by mass loss of 23.07%, is due to pyrolysis of the residual citrate, residual nitrate and TEOS in the sample. According to the DTA-TG analysis, the heat processing treatment system of Eu^{2+}, Dy^{3+}-doped SrO-MgO-SiO_2 glass was determined.

X-ray diffraction pattern. Fig.2 shows the XRD pattern of the 40SrO-20MgO-40SiO_2: 0.1Eu^{2+}, 0.2Dy^{3+} glass. It could be found that there is no diffraction peaks in the XRD pattern, but two typical dispersion peaks of glass, which means there is no crystalline phase, and the sample is in a state of non-crystalline structure.

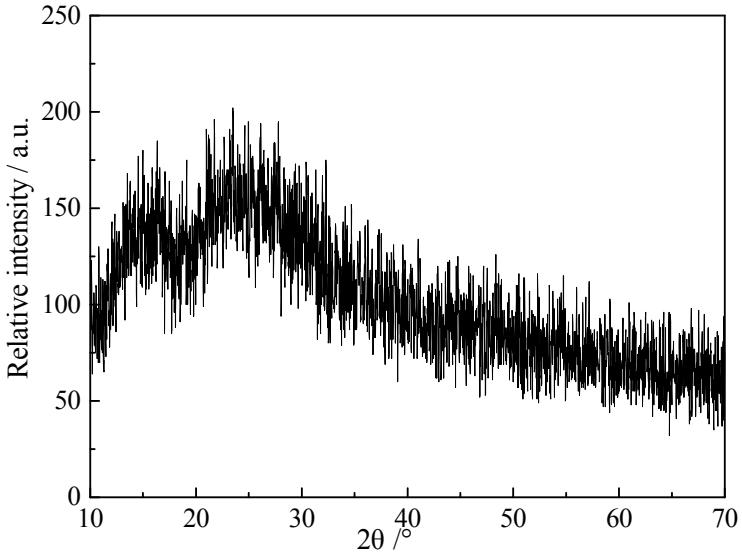

Fig.2 XRD pattern of the sample

Fluorescence spectra .

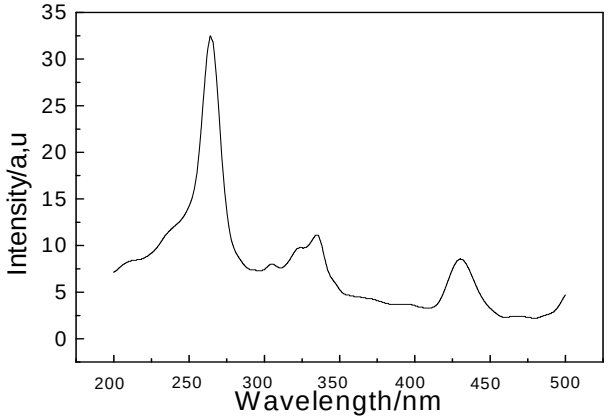

Fig.3 Emission spectra of the sample

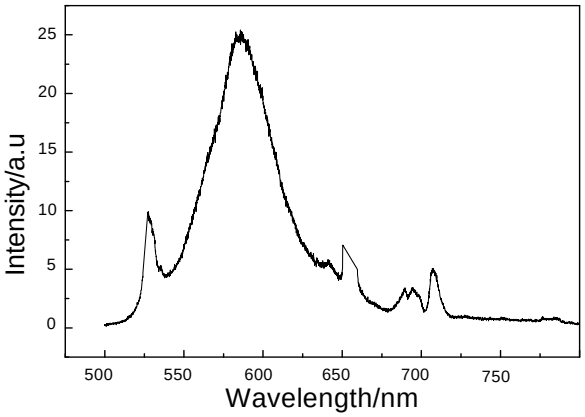

Fig.4 Excitation spectra of the sample

Fig.3 shows emission spectra of 40SrO-20MgO-40SiO_2: 0.1Eu^{2+}, 0.2Dy^{3+} glass. The excitation spectra revealed three excitation bands such as 230~300nm, 350~400nm, 400~450nm. stronger broadband absorption occurs at 270nm, which belongs to the electron charge excitation stage transition of $Dy^{3+}\rightarrow O^{2-}$. The other bands are due to the transition of Eu^{2+}. Fig.4 shows Excitation spectra.The spectra excited at 530nm, 587nm, 654nm, 704nm and 718nm which ascribed to the $^5D_i(i=0,1)\rightarrow{}^7F_j(j=0\sim4)$transition of Eu^{3+} ion.

Conclusions

In conclusion, SrO-MgO-SiO_2:Eu^{2+}, Dy^{3+} glass was prepared by sol-gel method. Heat treating process, luminescence properties and glass structure were attributed and analysed by luminescence spectra, XRD pattern, and DTA-TG and so on, which indicate that this glass with outstanding luminescence property has a huge potentiality in the information processing area.

Acknowledgements

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