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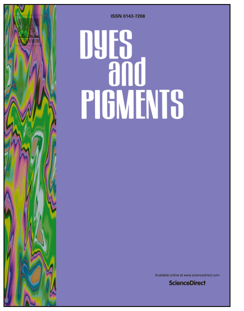

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Thermosensitive luminous fiber based on reversible thermochromic crystal violet lactone pigment

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Abstract

The aim of this work is to investigate the luminescence color changes of thermosensitive luminous fibers (TLFs). These TLFs are comprised of rare-earth luminescent materials as the luminescence sources, reversible thermochromic crystal violet lactone (CVL) pigment as the luminescence conversion agent, and polyacrylonitrile (PAN) as the matrix. It was found that the TFLs could not only change their color, but also convert the luminescence upon temperature change based on a structural transformation of the CVL pigment. X-ray diffraction (XRD) measurements indicated that rare-earth luminescent materials maintained their basic crystal structure and the CVL pigment was not destroyed by the process of spinning. The scanning electron microscopy (SEM) images of TLFs at the microcosmic angle showed that the CVL pigments were evenly distributed in the PAN matrix and formed a luminescence filter on the surface of the fiber. The differential scanning calorimetry (DSC) and thermogravimetry (TGA and DTG) results indicate that the TLFs possess satisfactory thermostability below 212.6 °C. The color and luminescence of the TLFs were accurately exhibited on the CIE 1931 chromaticity coordinates. The thermosensitive capability of TLFs was qualitatively verified by observing them in water at 40 °C and it was found that the fibers had brilliant luminescence and vivid thermosensitivity.

Keywords: Crystal Violet Lactone, Thermosensitivity, Rare earth, Luminescence, luminous fibers

1. Introduction

Luminous fibers prepared from rare-earth luminescent materials and fiber-forming polymers are promising functional materials because of their high brightness, long afterglow time, and stability. Through years of research, significant progress has been made in improving the luminescence performance of such fibers. Commercially available rare-earth luminescent materials such as $Sr_2ZnSi_2O_7$:Eu^{2+}, Dy^{3+} (SZSO), $SrAl_2O_4$:Eu^{2+}, Dy^{3+} (SAO), and Y_2O_2S:Eu^{3+}, Mg^{2+}, Ti^{4+} (YOS) emit blue, green, and red luminescence, respectively, and have been used to prepare luminous fibers[1-4]. Polyethylene terephthalate (PET), polypropylene (PP), cellulose, and polyacrylonitrile (PAN) are fiber-forming polymers and are conventionally used as matrices for preparing luminous fibers. Luminous fibers with compound light can be prepared by blending binary or ternary rare-earth luminescent materials [5-7]. Ternary luminous fibers based on the three additive primary fibers SZSO, SAO, and YOS, can emit polychromatic luminescence [8, 9]. Luminous fibers with white luminescence have also been prepared via adjusting the ratios of SZSO, SAO, and YOS. These studies have laid the

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