Luminescence of Eu^{3+} Complex/ soluble Polyimide Nano-composites

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Polyimide is a type of high-performance polymer widely applied in various industries because of their outstanding chemical resistance, mechanical properties, electrical properties, and radiation resistance, especially at elevated temperature. Recently, polyimide containing inorganic nano-particles has attracted a lot of attention due to their outstanding properties [1]. Among the inorganic materials, rare earth has been widely studied due to its optical properties and large coordinate ability, and some of the hybrid of rare earth with common polymer has been prepared. However, the reports on the polyimide containing rare earth are mainly on improving the physic properties of PI. For example, southward et al. [2, 3] has worked on the hybrid of fluorinated polyimide doped with lanthanide ions. The results showed that lower the coefficient of thermal expansion (CTE) of hybrid has been obtained. However, to our best known, the photo-luminescence of the PI/rare earth nanocomposite has not been reported. In this study, we prepared the europium (III)/soluble polyimide nanocomposite and studied the luminescence.

In this study, Eu^{3+}—doped polyimide nano-composites were prepared through the soluble polyimide (MMDA/BTDA) and europium (III) pyridine carboxylic acid complex in DMF solution.

The fluorescent property of EuL_3/soluble PI nanocomposites was studied by fluorescence spectra. Obvious photoluminescence of Eu^{3+} can be observed in the nanocomposite (Fig.1 and Fig. 2). If the nanocomposite of PI/ EuL_3 was prepared through Eu^{3+} complex with poly (amic acid) solution which was based on two conventional monomers: benzophenone-3,3',4,4'-tetracarboxylic dianhydride (BTDA) and 4,4'-Oxydianiline (ODA), no photoluminescence of Eu^{3+} in the obtained naocomposite can be found. This may be due to the high coordinate ability of –COOH of poly(amic acid) which can hold the vacancy of Eu^{3+} and influence of the structure of rare earth and further quench the luminescence of rare earth ion. If the soluble PI was used, the reactive O atoms is fewer for soluble polyimide, and the interaction between Eu^{3+} and O atoms were not as same as in the poly(amic acid), Which was insufficient of changing the optical properties of Eu ions, so Eu^{3+} can possess good luminescent properties among these systems.

References

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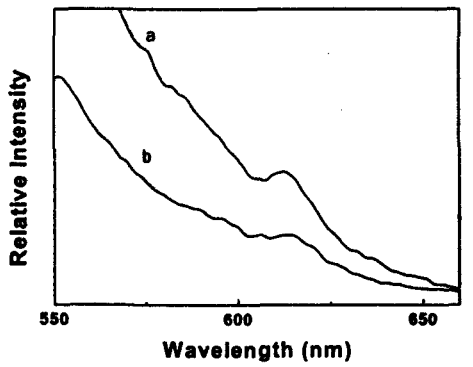

Fig. 1 Emission spectra of soluble polyimide doped with rare earth complex (EuL_3), λ_{ex}=258nm

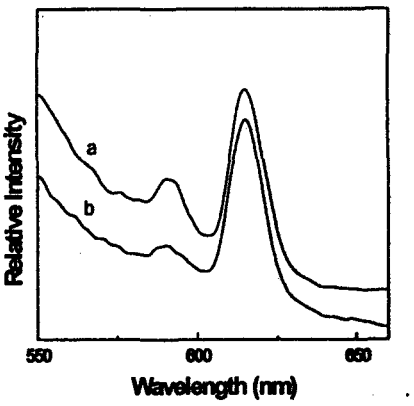

Fig.2 Emission spectra of soluble polyimide doped with rare earth complex ($Eu(AA)_3Phen$), λ_{ex}=395nm