

Effect of Swift heavy ion irradiation on Tris-(8-hydroxyquinoline) aluminum thin films

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Abstract: *Tris-(8-hydroxyquinoline)aluminum (Alq₃) is the most widely used light-emitting and electron transport materials in organic electroluminescent (EL) devices to date. Alq₃ thin films have been deposited on glass substrates by thermal evaporation process. The deposited Alq₃ thin films have been irradiated with Swift heavy ion (SHI) of Li³⁺ 40 MeV with various ion fluences. The effect of SHI irradiation on Alq₃ thin films has been analyzed using UV-Visible, and Photoluminescence (PL) spectroscopy. It is found that the PL intensity of irradiated Alq₃ thin films decreases for increasing ion fluences from that of as-prepared Alq₃ thin film. It is concluded that the energy of excitons in the irradiated Alq₃ thin films can be nonradiatively transferred to luminescent quencher formed by SHI irradiation.*

Keywords: Swift heavy ion irradiation; Alq₃; Photoluminescence.

Introduction

Research interest on the organic semiconducting materials is growing because of their potential to achieve low-cost, full color flat-panel displays. Alq₃ still remains as a prototype organic luminescent semiconductor material in organic light emitting diodes (OLEDs). However, OLEDs based on Alq₃, the most widely used electroluminescent material, show relatively poor stability. In the present work, an attempt is made to study the effect of SHI irradiation on the PL efficiency of Alq₃ thin films. Alq₃ thin films were irradiated with SHI of 40 MeV Li³⁺ for the ion fluences of 1x10¹¹, and 1x10¹² ions/cm². UV-Visible and Photoluminescence (PL) studies were carried out on the as-prepared and irradiated Alq₃ thin films.

Experiment

Alq₃ thin films have been deposited on glass substrates by thermal evaporation process under vacuum of ~5x10⁻⁶ Torr. Alq₃ thin films having dimensions about 1cm X 1cm were irradiated with SHI of 40 MeV Li³⁺ ions for the ion fluences of 1X10¹¹, 1X10¹² ions/cm² at room temperature at Inter-University Accelerator Centre (IUAC), New Delhi. From the SRIM calculations, it is found that there is no implantation of these ions in the Alq₃ thin films. The absorption spectra of the as-prepared and irradiated Alq₃ thin films were measured using Shimadzu UV 1601 spectrometer. The PL spectra of

the both as-prepared and irradiated Alq₃ thin films were recorded using spectrofluorometer (fluorolog-3, JobinYvon).

Results and discussions

UV-Visible Spectroscopy: The UV-Visible spectra of as-prepared and SHI irradiated Alq₃ thin films are presented in the figure 1. The characteristic absorption peak of as-prepared Alq₃ thin film is observed at a wavelength of 380 nm, which is consistent with earlier report. It is also observed that the absorption peak intensities of SHI irradiated Alq₃ thin films decrease for increasing ion fluences. The decrease in the absorption intensities of irradiated Alq₃ thin films compared with that of as-prepared Alq₃ thin film indicates that the SHI irradiation is inducing luminescent quenchers which are increasing for increasing ion fluences

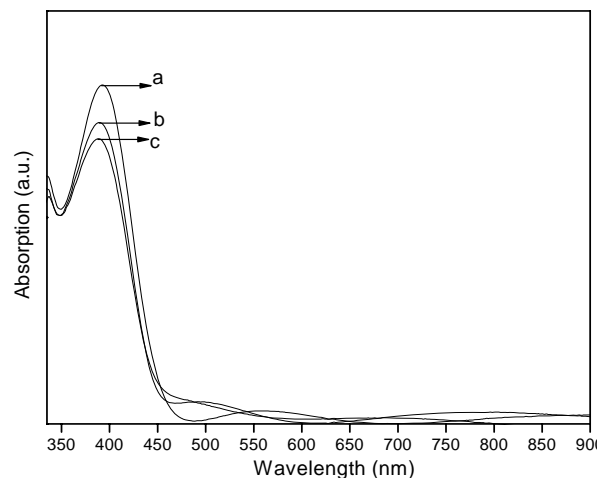


Figure1. UV-Visible spectra of (a) as-prepared and SHI (40 MeV Li³⁺ ions) irradiated Alq₃ thin films with the ion fluences of (b) 1X10¹¹, (C) 1X10¹² ions/cm.

Photoluminescence Spectroscopy: The figure 2 shows the PL spectra of as-prepared and SHI irradiated Alq₃ thin films. The peak at ~515 nm wavelength is observed for the as-prepared Alq₃ thin film which is consistent with earlier report. It is observed that the peak intensities of all irradiated Alq₃ thin films are decreasing for increasing ion fluences. The decrease in the PL intensities of Alq₃ thin films irradiated with SHIs of 40 MeV Li³⁺ compared with that of as-

prepared Alq₃ thin films indicates that excitons energy in the SHI irradiated Alq₃ thin films can be non radiatively transferred to the luminescent quencher formed by SHI irradiation.

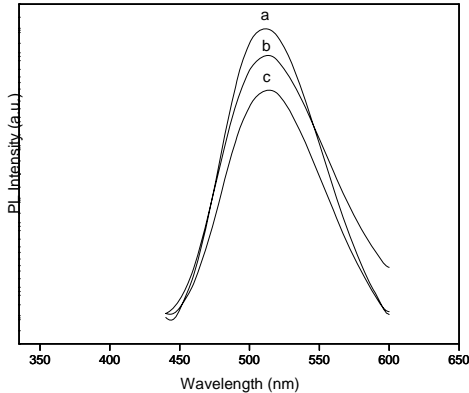


Figure 2. PL spectra of (a) as-prepared and SHI (40 MeV Li³⁺ ions) irradiated Alq₃ thin films with the ion fluences of (b) 1X10¹¹, (C) 1X10¹² ions/cm.

Conclusion

Alq₃ thin films have been deposited on glass substrates by thermal evaporation process. The Alq₃ thin films have been irradiated with swift heavy ions of 40 MeV Li³⁺ ions in order to study the effect of

SHI irradiation on the PL properties of Alq₃ thin films. From the PL studies, it is found that the PL intensities of irradiated Alq₃ thin films decrease compared with that of as-prepared Alq₃ thin film for increasing ion fluences. It is confirmed the SHI irradiation induces the luminescent quenchers and the amount of luminescent quencher increases for increasing ion fluences. The energy of excitons can be non-radiatively transferred to luminescent quenchers.

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