Syntheses and Electro-Optical Properties of a Silsesquioxane(POSS) Core Star-like Light Emitting Materials

Abstract

We have synthesized three novel light emitting materials (POSS 1 ~ POSS 3), which utilize polyhedral oligomeric silsesquioxanes (POSS) as the cores to link the chromophores. The chromophores can be fluorescence (C-1, C-2) and phosphorescence (C-3) dyes. These three star-like light emitting materials were synthesized by hydrosilylation of Si-H groups on the POSS cores and the vinyl end group of the chromophores using Pt as catalyst.

POSS 1 ~ POSS 3 have similar absorption and photoluminescent spectra with their corresponding chromophores. It means that the silsesquioxane core does not affect the energy gap of the light emitting materials. The thermal degradation temperatures of POSS 1 ~ POSS 3 are higher than those of chromophores C-1 ~ C-3. Furthermore, the annealing experiments show that the PL spectra of POSS 1 ~ POSS 3 are more stable than those of chromophores C-1 ~ C-3. These results indicate that the incorporation of the silsesquioxane core could enhance the thermal and luminescent stabilities of the obtained light emitting materials.

POSS 1 emitts blue green light at 476 nm, POSS 2 emitts green light at 496 nm, while POSS 3 emitts yellow green light at 524 nm. The star-like light emitting materials show good film forming property. Therefore they can be used to fabricate devices by spin coating process. The single-layer LED devices with

the configuration of ITO/PEDOT/POSS n:PVK:PBD/Ca/Al for POSS 1, POSS 2 show maximum brightness of 1102 cd/m^2 and 1468 cd/m^2 respectively and maximum quantum efficiencies of ca. 1 cd/A. The maximum brightness of the device with the configuration of ITO/PEDOT/POSS 3:CBP/LiF/Ca/Al is 1458 cd/m^2. After blending the hole blocking material TPBI with POSS 3, the maximum quantum efficiency can be increased up to 3.99 cd/A. In addition, their EL spectra are stable even at high voltages.

Finally, the crystal structure and morphology of the star-like light emitting materials, POSS 1 ~ POSS 3 were studied by wide-angle X-ray diffraction (WAXD) and scanning electron microscopy (SEM). X-ray diffraction results show that the *d*-spacings of the POSS 1 ~ POSS 3 nanocrystals are larger than that of pure POSS. The SEM analysis reveals that POSS 1 ~ POSS 3 form the nanocrystals with diameter of about 20 nm. The size distribution of the nanocrystals is very uniform.