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Syntheses and characterization of heteroleptic Ir(III) complexes dispersed in PMMA films and their application as UV-LEDs coating

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Luminescent iridium complexes has been extensively studied due to their high quantum yield, long emission lifetime, chemical stability, and easily tunable color emission, which ranges from blue to red depending on the energy of the ligands coordinated to the iridium ion, making them excellent for composing an emissive layer in various optoelectronic devices[1-2]. Thus, this work describes the syntheses and spectroscopic characterization of two heteroleptic complexes, and their use as downshifting coatings of near-UV-emitting LEDs based on phosphor-converted LED (PC-LED) strategy. For the syntheses of heteroleptic Ir(III) complexes, the precursor dimer $[(fppy)_2Ir(\mu\text{-}Cl)_2Ir(fppy)_2]$ (fppy = 2-(2,4-difluorophenyl)pyridine) was dissolved in dichloromethane and stirred at room temperature. Subsequently, an aqueous solution of the ancillary ligand, Hbpy or Hqpy (Hbpy=2,2'-bipyridine-4-carboxylic acid, or Hqpy=2-Pyridin-2-yl-quinoline-4-carboxylic acid), was added to the dimer solution, forming a biphasic system. The solution was stirred at room temperature for additional 4 h, during which the complexes precipitated in the aqueous solution. The formation of complexes was confirmed using FTIR, UV-Vis spectroscopy, ^{1}H-NMR, and mass spectroscopy techniques. The complexes were then immobilized in PMMA films at mass percentages ranging from 0.10% to 1.0%, via the drop casting technique on glass substrate. Photoluminescence spectroscopy of the PMMA films revealed emission in the green region for the $[Ir(fppy_2(bpy)]$ complex series, with an emission maximum red-shift with increasing concentration. Films containing the $[Ir(fppy)_2(qpy)]$ complex exhibited orange emission, with a similar red-shift with varying concentration. Films containing 0.25% of the two complexes were selected for coating the near-UV LED (λ_{max} = 395 nm). The prototypes had a loss of less than 30% of their initial intensity after 24 h of operation, maintaining the characteristic emission colors of each complex in the green ($[Ir(Fppy)_2(bpy)]$) and in the orange ($[Ir(Fppy)_2(qpy)]$) regions. Therefore, these results indicate that these films are promising as emitting components in the construction of LED lamps for lighting.

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References

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