MULTI-COLOR FLUORESCENT / PHOSPHOLESCENT POLYIMIDES WITH VERY LARGE STOKES SHIFTS AND THEIR PERFORMANCE FOR SOLAR SPECTRAL CONVERSION

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Polymeric materials exhibiting fluorescent and phosphorescent emission are expected to be applied for wavelength down-converters in a wide range of applications such as flat panel displays, flexible displays, photovoltaic devices, and crop cultivators. However, conventional fluorescent polymers consisting of π-conjugated sequences do not have sufficient mechanical properties and thermal, environmental, and radiation stabilities.

In 2009, we have reported that a series of semi-aromatic polyimide (PI) films exhibit strong blue to green fluorescent emission [1]. The high quantum efficiency ($\Phi > 0.11$) was attributable not only to suppression of charge-transfer (CT) interactions, but also to enhancement of the locally excited π−π^* transition and effective suppression of concentration quenching by steric effects [2]. We have recently reported a series of imides and PIs containing one or two −OH groups which form ideal intramolecular hydrogen bonds between the −OH and C=O groups exhibit strong and tunable multi-color (blue, green, yellow, to deep red) fluorescence with very large Stokes shifts (7,655~11,394 cm^{-1}) via excited-state intramolecular proton transfer (ESIPT) [3−6]. Moreover, the corresponding deprotonated mono- and di-anion species are formed in basic conditions, which are characterized by visible halochromism in their absorption and emission spectra [4,5]. Copolymer films derived from blue- and red-fluorescent PIs exhibit strong absorption in the UV region, and the transmission intensities in the visible blue and orange regions are obviously enhanced by ~16 % due to the fluorescent emission. Very recently, we have developed highly phosphorescent PIs by introducing heavy halogens (Br, I) in the skeletal structures of dianhydrides [7]. Judicious design of highly fluorescent/phosphorescent PIs are promising for fabricating tough and flexible wavelength converters which efficiently absorb UV radiation in the solar or LED light and emit tunable visible to near-infrared radiation without consuming external energy.

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