Materials Science & Engineering Doctoral Defense

Novel Organic Materials for Light Emitting Diodes and Neuromorphic Devices

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Abstract

Organic materials have emerged as an attractive component of electronics over the past few decades, particularly in the development of efficient and stable organic light emitting diodes (OLEDs) and organic neuromorphic devices. The electrical, chemical, physical, and optical studies of organic materials and their corresponding devices have been conducted for efficient and stable electronics. The development of efficient and stable deep blue OLED device remains a challenge that has obstructed the progress of large-scale OLED commercialization. One approach was taken to achieve a deep blue emitter through a color tuning strategy. A new complex, PtNONS56-dtb, was designed and synthesized by controlling the energy gap between T1 and T2 energy states to achieve narrowed and blueshifted emission spectra. This emitter material showed an emission spectrum at 460 nm with a FWHM of 59 nm at room temperature in PMMA and the PtNONS56-dtb-based device exhibited a peak EQE of 8.5% with CIE coordinates of (0.14, 0.27).

A newly developed host and electron blocking materials were demonstrated to achieve efficient and stable OLED devices. The indolocarbazole-based materials were designed to have good hole mobility and high triplet energy. BCN34 as an electron blocking material achieved the estimated LT80 of 12509 h at 1000 cd/m2 with a peak EQE of 30.3% in devices employing Pd3O3 emitter. Additionally, a device with bi-layer emissive layer structure, using BCN34 and CBP as host materials doped with PtN3N emitter, achieved a peak EQE of 16.5% with the LT97 of 351 h at 1000 cd/m2.

A new neuromorphic device using Ru(bpy)3(PF6)2 as an active layer was designed to emulate the short-term characteristics of a biological synapse. This memristive device showed similar operational mechanism with biological synapse through the movement of ions and electronic charges. Furthermore, the performances of the device showed tunability by adding salt. Ultimately, the device with 2% LiClO4 salt shows similar timescales to short-term plasticity characteristics of biological synapses.

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Zoom Link: https://asu.zoom.us/j/87321774097