Engineering Negative Surface Potential to Reduce Exciton Quenching in OLEDs

Can an optimized negative GSP mitigate energy waste by suppressing exciton–polaron quenching (EPQ) without causing excessive interfacial charge trapping?

Methodology

Designing negative GSP molecules

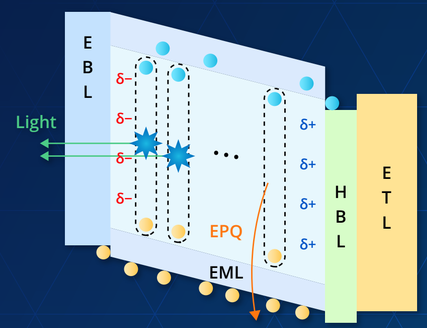
GSP characterization

OLED fabrication and testing

Charge and exciton analysis

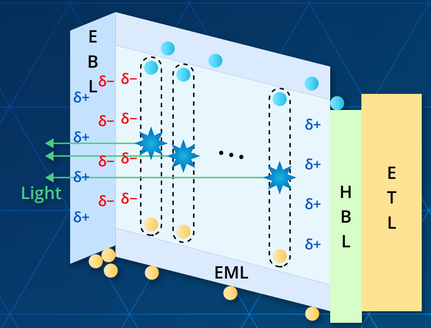
Three GSP conditions in OLEDs

Weak or absent negative GSP (−1 mV/nm)



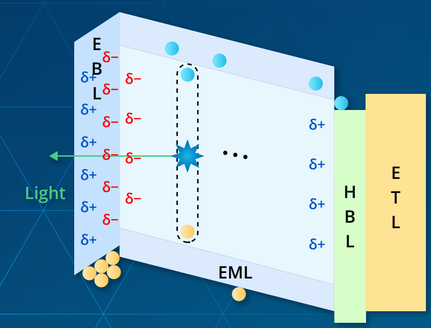
Excess hole accumulation → more quenching

Optimized negative GSP (−40 mV/nm)



Balanced hole injection → less quenching

Excessively strong negative GSP (−87 mV/nm)



Over-suppressed hole injection → lower efficiency

Key findings

Regulates interfacial charges
Negative GSP controls hole injection and trapping

Extends device lifetime
Optimized o-CBP device: LT95 = 35 h; 119.5% improvement

Suppresses EPQ
Optimized GSP reduces excess-hole-related energy loss

Avoids excessive GSP
Over-suppressed injection lowers efficiency and lifetime

GSP: giant surface potential; OLEDs: organic light-emitting diodes; EML: emitting layer; ETL: electron-transport layer; EBL: electron-blocking layer; HBL: hole-blocking layer; LT95: time to 95% of initial luminance

Optimized negative GSP balances charge injection, suppresses exciton quenching, and improves OLED performance

Negative Giant Surface Potential Engineering for Suppressing Exciton–Polaron Quenching in Organic Light-Emitting Diodes
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