Engineering OLED Device Structures for Enhancing the Purcell Effect

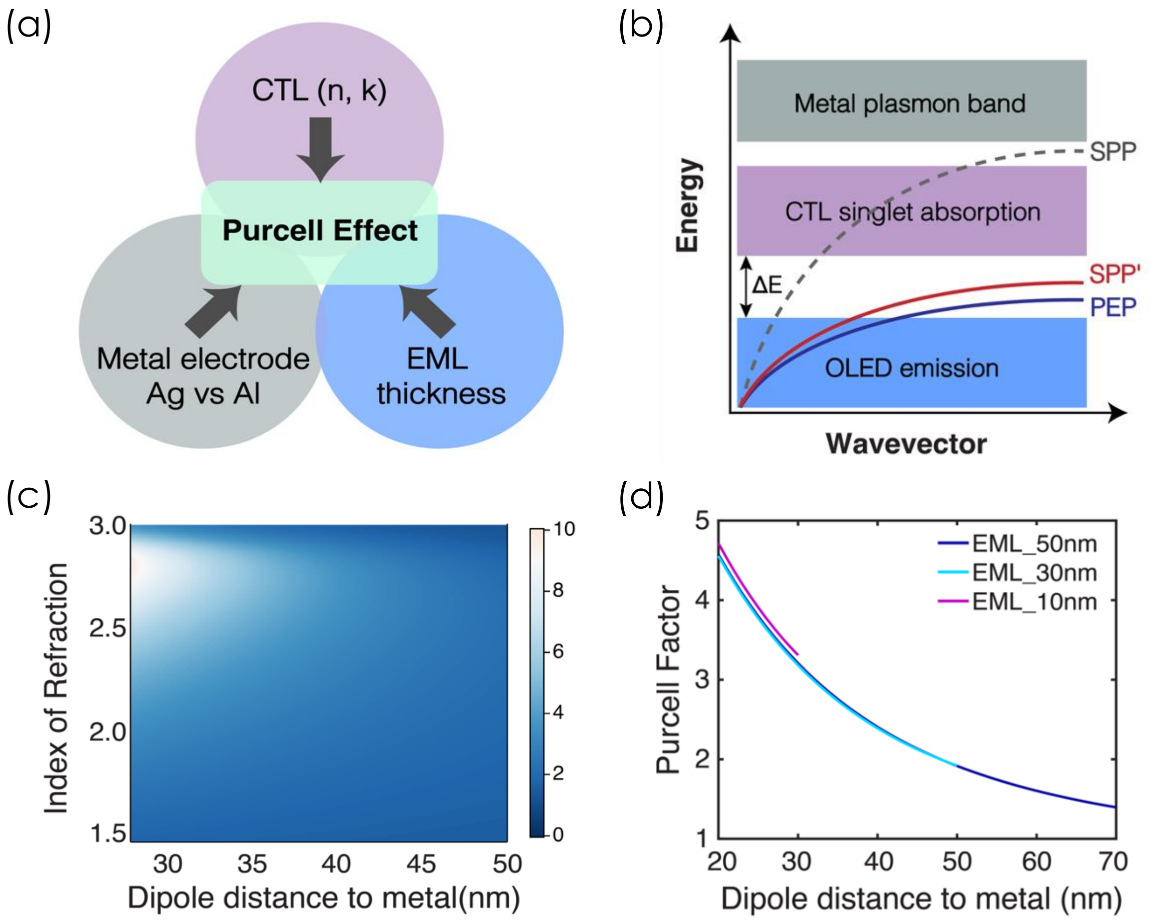

Figure: (a) Key parameters for enhancing the Purcell effect. (b) Energy diagram of metal plasmon, OLED emission and charge transporting layer singlet absorption. (c) Simulated Purcell factor as a function of the index of refraction of ETL in OLED, and the dipole distance in EML. (d) Simulated Purcell factors for device structures with different EML thicknesses.

Objective

➢ Demonstrate the principle of PHOLED structure design for enhancing the Purcell effect that can improve device operational lifetime.

Impact

The operational lifetime of PHOLEDs is limited by triplet-triplet annihilation and triplet-polaron annihilation. Increasing the radiative decay rate of triplet excitons by the Purcell effect can reduce triplet density in the emission layer. Here, we demonstrate that the optical constants of the charge transporting layers are crucial for enhancing the Purcell effect. The Purcell effect is also shown to strongly depend on the optical field intensity in the OLED cavity depending on the choice of metal used in the cathode, and emission layer thicknesses. This can ultimately increase the device operational lifetime.

Facilities and Methods Used

- Optical simulation using the dyadic Green's function
- Transfer matrix simulation
- Vacuum thermal evaporation
- J-V-L and device lifetime testing station

Relevant Papers

- H. Zhao, C. E. Arneson, D. Fan and S. R. Forrest, *Nature* 626, 300 (2024).

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