

The effect of Purcell cavities on the lifetime of thermally activated delayed fluorescent emitters

Objective

➤ To study the effect of Purcell cavities on two classes (metal-containing and metal-free) of thermally activated delayed fluorescent (TADF) emitters based on their photophysical and device properties

Impact

We observe a doubling of the emission rate of carbene-metal-amide (cMa) TADF molecules with fast intersystem crossing (ISC) rates due to coupling to surface plasmon polariton modes in a Ag cathode. Temperature-dependent photophysical characterization reveals that the cavity equally increases both singlet and triplet exciton radiative rates. The larger emission rate results in a 1.3 times enhancement in the device lifetime of a cMa TADF OLED in a weak Purcell cavity, exhibiting an increased time for the luminance to decay. In comparison, the Purcell cavity has a smaller impact on the emission rate of a metal-free emitter due to the slower non-radiative endergonic ISC rate than the singlet radiative rate.

Facilities and Methods Used

- Vacuum thermal evaporation
- Sputtering and wet-etching
- Photolithography
- JVL, EL and device lifetime setup
- Temperature dependent transient photoluminescence

Relevant Papers

- S. Paul, et al., Adv. Funct. Mater., DOI: 10.1002/adfm.202522114

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- US Department of Energy
- Universal Display Corporation

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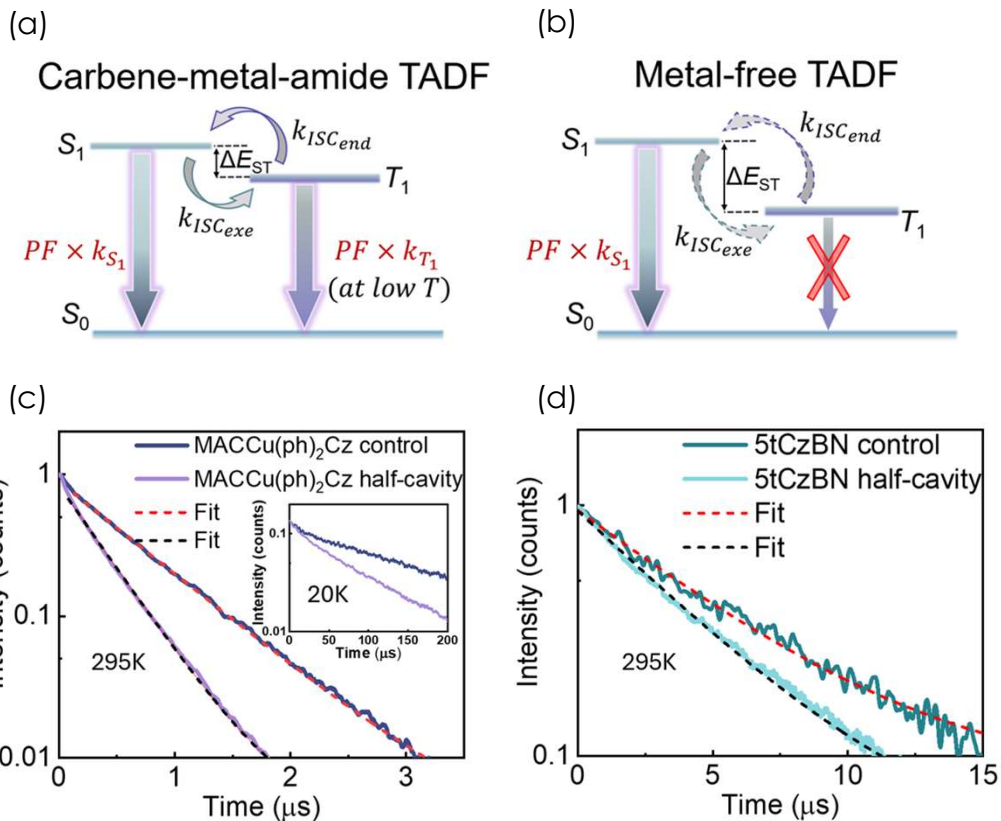


Figure: Excitonic states and equilibrium rate constants in a cavity with Purcell factor = PF for a (a) cMa and (b) metal-free TADF emitter. Transient photoluminescence spectra of (c) cMa and (d) metal-free TADF samples with and without cavity, and their fits to a single exponential decay.