Supplementary Information

1. Example of statistical analysis of layer thickness

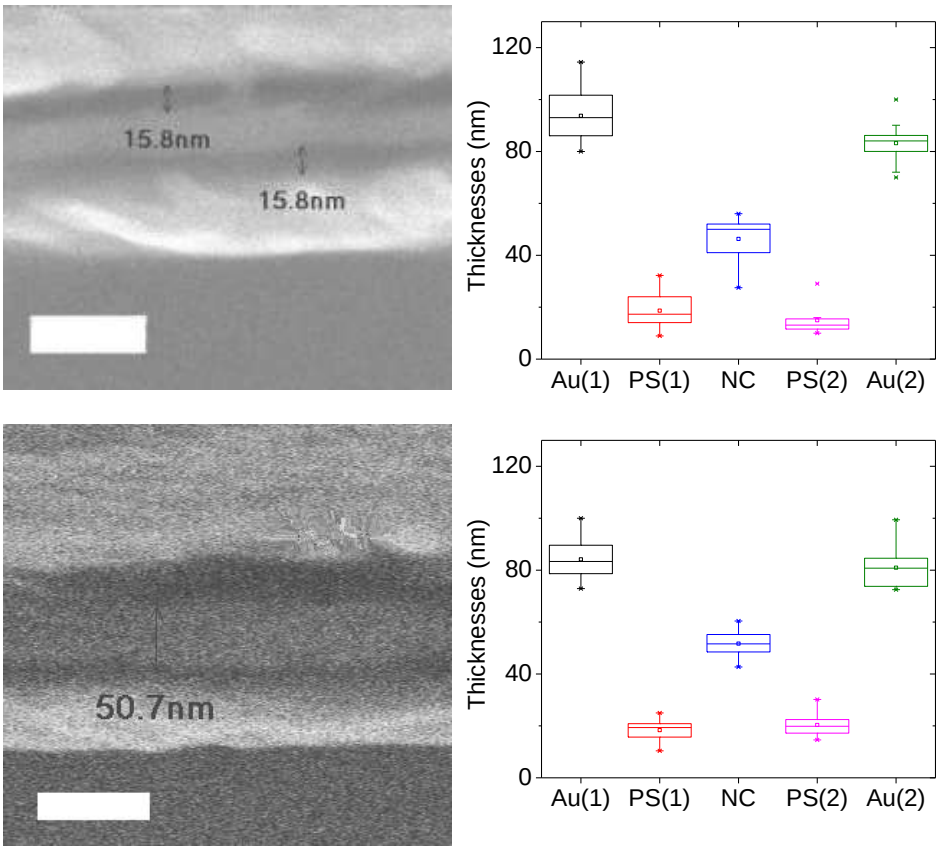

Figure S1. Example of statistical analysis of layer thickness: statistical analysis of layer thicknesses of two separate 50nm-thick $CsPbBr_3$ nanocrystal (NC) metal-emitter-metal (MEM) structure, showing the repeatability of layer thicknesses across two separate samples.

2. Schematic of reference sample in photoluminescence (PL) and time-resolved PL (TRPL) measurements

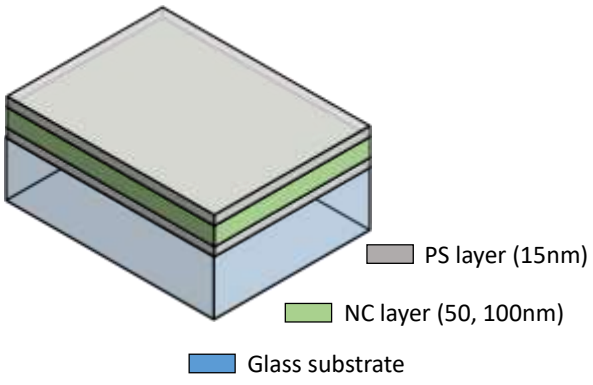

Figure S2. Schematic of reference sample in PL and TRPL measurements

3. Transmittance of ME and MEM structures

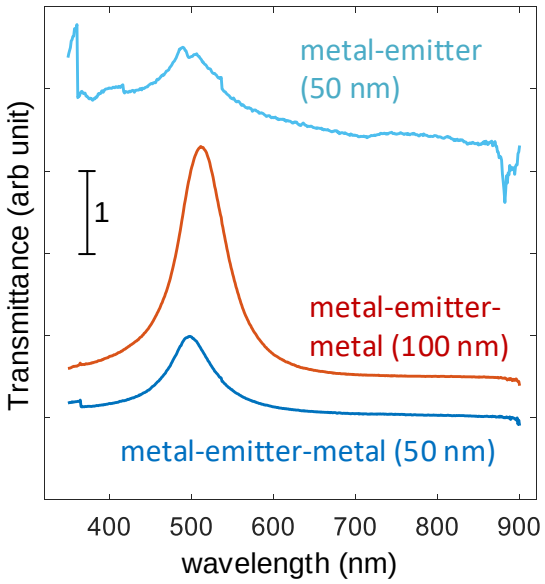

Figure S3. Transmittance of ME and MEM structures: $CsPbBr_3$ NC film in ME (50 nm thickness) and MEM (50nm and 100 nm thickness) configurations.

4. Calculation of top gold layer absorption and estimation of PLE of MEM structure

In our transmittance/absorbance measurement (using Shimadzu UV2450, shown in Fig. S4), we normalized the signals of our samples with those of a bare glass. As shown in Fig.S4a, the resonance features are clearly observed in MEM structure, as expected from the strong reflections of the top and bottom gold layers. This contrasts with the relatively "flat" transmittance of the ME structure, which has less prominent resonance peak around the same spectral position at ~500 nm (which also coincides with the emission wavelength of $CsPbBr_3$ NCs. Indeed, the presence of resonance effects in our measurements made it difficult to measure the transmittance/absorbance of individual layers. However, as the 355nm excitation wavelength is far from the resonance (at ~500 nm), it is possible to estimate the transmittance across the top gold layer at 355nm. In such an "off-resonance" situation, where the back and forth reflections within the perovskite NC thin film are negligible, the transmittance is approximately the product of individual transmittances of each layer. In order to validate this assumption, we perform a comparison between the transmittance of the MEM structure (T_{MEM}) and the square of the transmittance of the MEM structure (i.e., T_{ME}^2), as shown in Fig. S4b. Here, the T_{ME}^2 is used to add the presence of the top gold layer without introducing resonance effects (as with the MEM structure). As expected from the much weaker resonance effects in ME structure, around the resonance position, the T_{ME}^2 appears to be flat and much smaller in magnitude compared to the T_{MEM}. This is to be expected from the "constructive interference" properties around the resonance. On the other hand, at off-resonance spectral region ($\lambda < 400nm$ and $\lambda > 600nm$), we have $T_{MEM} < T_{ME}^2$, as expected from "destructive interference" properties of the FP resonance.

Given the much weaker resonance effects in the ME structure, it is possible to estimate the transmittance across the gold layer. In the off-resonance situation, the transmittance at 355nm of the metal-emitter structure can be expressed as $T_{ME} \approx T_g T_E$, where T_g is the transmittance of the bottom gold layer, and T_E is the transmittance between the perovskite thin film and air. Note that the transmittance across the

PS interlayer is not considered due to its much smaller thickness (~15nm) and small index contrast (with respect to the perovskite). Using the measured refractive index of $CsPbBr_3$ NCs (referring to Fig. 4b in our manuscript) of ~2.3, we estimate the transmission of the emitter layer as $T_E = 1 - (2.3-1)^2/(2.3+1)^2 \approx 0.84$. Using the measured transmittance of $T_{ME} = 0.0618$ at 355nm, and substituting $T_E = 0.84$, we have $T_g = 0.0725$.

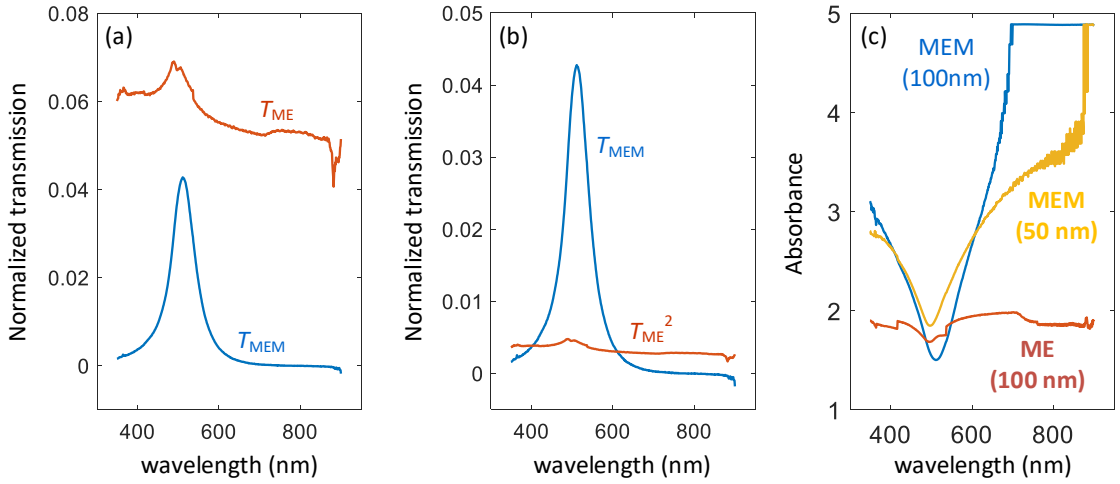

Figure S4. Transmission and absorbance of ME and MEM structures: (a) Normalized transmission of ME and MEM structure with 100 nm thick $CsPbBr_3$ NC film, (b) Comparison between T_{ME}^2 and T_{MEM}, (c) Absorbance for MEM (with 100 nm NC film $CsPbBr_3$), MEM (with 50 nm $CsPbBr_3$ NC film) and ME (with 100 nm $CsPbBr_3$ NC film).

PL intensity ratio (PLR) in the manuscript (see Table 1) is the ratio of measured PL intensity of the ME or MEM structure, over the measured PL intensity of the reference structure. As the excitation source is first absorbed by the top gold layer before being absorbed by the perovskite thin film, the excitation power thus needs to be adjusted to be $P_{exc} = P_{exc}^{ref} T_g(\lambda = 355nm)$. This means that the intensity ratio of MEM structure after the absorption in gold is taken into account is $\sim PLR/T_g(\lambda = 355nm)$. Using $PLR = 1.18$ (see Table 1) and $T_g(\lambda = 355nm) = 0.0725$, the intensity ratio for MEM structure becomes 16.3. Furthermore, given that the emission needs to pass the top gold layer, the PL intensity enhancement (PLE) within the perovskite thin film can be further estimated by $\sim PLR/T_g(\lambda = 355nm)T_g(\lambda = 505nm)$, with $T_g(\lambda = 505nm)$ as the transmittance of the gold layer at the emission wavelength. We note that the much higher enhancement inside the cavity is as expected and in good agreement with the FEM results in Fig 4d, where the electric field intensity is much higher inside the cavity (as compared to the outside). Since $T_g(\lambda = 505nm)$ falls in the resonance region, the actual value is not accurate. Therefore, we estimate PLE for MEM structure $\gtrsim$16.3.

5. Comparison with system without PS spacer layer

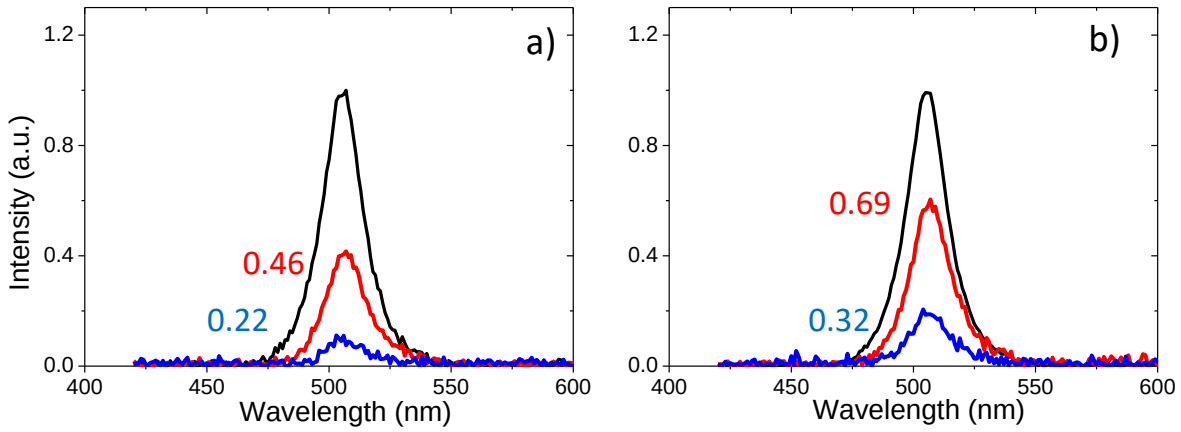

Figure S5. PL spectra of $CsPbBr_3$ NC-Au layers (without PS) at room temperature (RT). Spectra from layers with $CsPbBr_3$ NC films of (**a**) 50- and (**b**) 100-nm thick. The black, red, and blue lines correspond to $CsPbBr_3$ NC film reference, single-Au, and double-Au layers, respectively. The coloured numbers indicate the ratios of integrated intensities in comparison to those of the references.

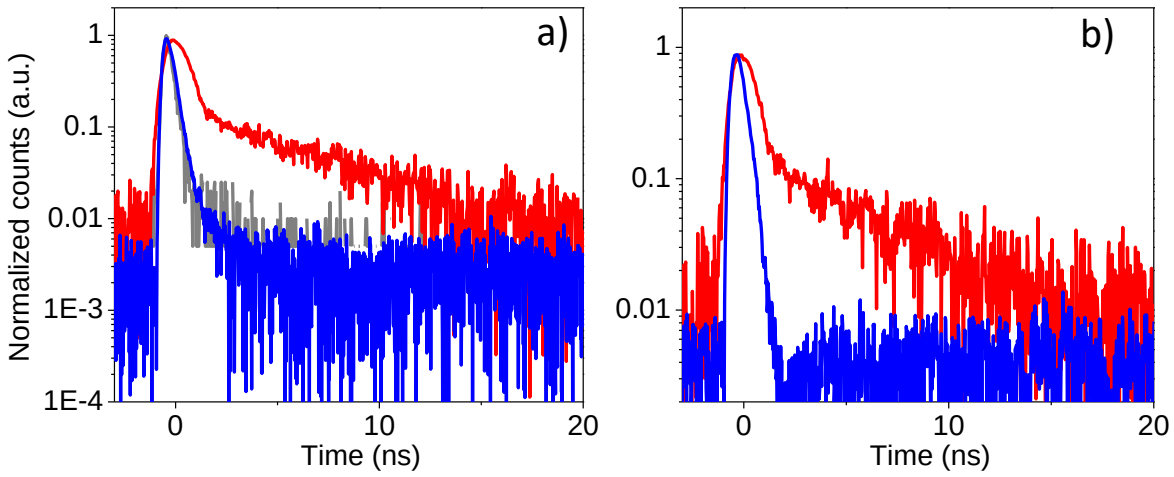

Figure S6. TRPL decay curves of $CsPbBr_3$ NC film with Au. Decay curves of single-Au- (red), and double-Au-NC samples (blue) measured for (**a**) 50- and (**b**) 100-nm-thick $CsPbBr_3$ NCs. The grey line is the instrument response function.

6. Emission rate calculation

The TRPL decay curves in Figure 3(d) were fitted with two exponential functions using the following equation:

$$N(t) = N_1(0)\exp\left(\frac{-t}{\tau_1}\right) + N_2(0)\exp\left(\frac{-t}{\tau_2}\right) \qquad (S2-S1)$$

where $N(t)$ is the total number of populations from all emission channels after t time. $N_1(0)$ and $N_2(0)$ are the initial population at t = 0, which represent emission lifetimes for fast and slow channels of τ_1 and τ_2, respectively.

The weightage of each decay component given by:

$$W_i(\%) = \frac{A_i t_i}{\sum A_i t_i} . 100\% \qquad (S2 - S2)$$

The average emission lifetime τ_{ave} is given by:

$$\tau_{ave} = \frac{\sum(W_i(\%) \times \tau_i)}{100\%} \qquad (S2 - S3)$$

Table S1 shows key parameters derived from fitting and the emission rate γ_{total} is calculated using the following equation:

$$\gamma_{total} = \frac{1}{\tau_{ave}} \qquad (S2 - S4)$$

where τ_i and A_i are decay times and amplitudes from fitted TRPL decay curves with two exponential decay function.

Table S1: Key parameters of TRPL decay curves

NC layer	NC layer thickness	Metal layer	τ_{ave}(ns)	τ_1(ns)	W_1 (%)	τ_2(ns)	W_2 (%)
$CsPbBr_3$	50nm	none	6.0 ± 3.6	2.1	21	7.1	79
		single	3.0 ± 1.7	1.3	32	3.8	68
		double	1.4 ± 0.8	0.6	28	1.7	72
$CsPbBr_3$	100nm	none	7.9 ± 4.9	2.2	17	9.1	83
		single	4.5 ± 2.8	1.4	21	5.4	79
		double	2.7 ± 1.7	0.7	17	3.1	93
$FAPbBr_3$	50nm	none	24.2 ± 16.1	3.2	9	26.4	91
		single	10.0 ± 6.6	1.4	10	11.0	90
		double	4.5 ± 3.0	0.6	10	4.9	90
$FAPbBr_3$	100nm	none	25.5 ± 17.0	3.2	10	27.8	90
		single	14.6 ± 9.7	2.0	11	16.2	89
		double	6.1 ± 4.1	0.8	9	6.7	91