Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Stable Deep Blue Emission with Unity Quantum Yield in Organic-Inorganic Halide Perovskite 2D Nanoplatelets Doped with Cerium and Terbium at High Concentrations

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Table S1: Details of time resolved PL decay components of various samples fitted with a tri-exponential decay function.

Sample	τ_1 *(ns)*	A_1 *%*	τ_2 *(ns)*	A_2 *%*	τ_3 *(ns)*	A_3 *%*	τ_{avg} *(ns)*
Ce0/Tb0	7.68	14.76	34.30	38.48	166.20	46.76	92.01
Ce20	3.70	19.77	14.77	43.28	76.09	36.95	35.25
Ce50	0.29	42.29	9.88	26.08	32.80	31.63	13.07
Ce70	-	-	6.28	100	-	-	6.28
Tb20	3.13	16.70	22.47	41.79	118.59	41.51	59.14
Tb50	0.57	30.79	7.28	11.45	57.98	57.76	34.44
Tb70	0.58	54.97	8.48	45.03	-	-	4.14

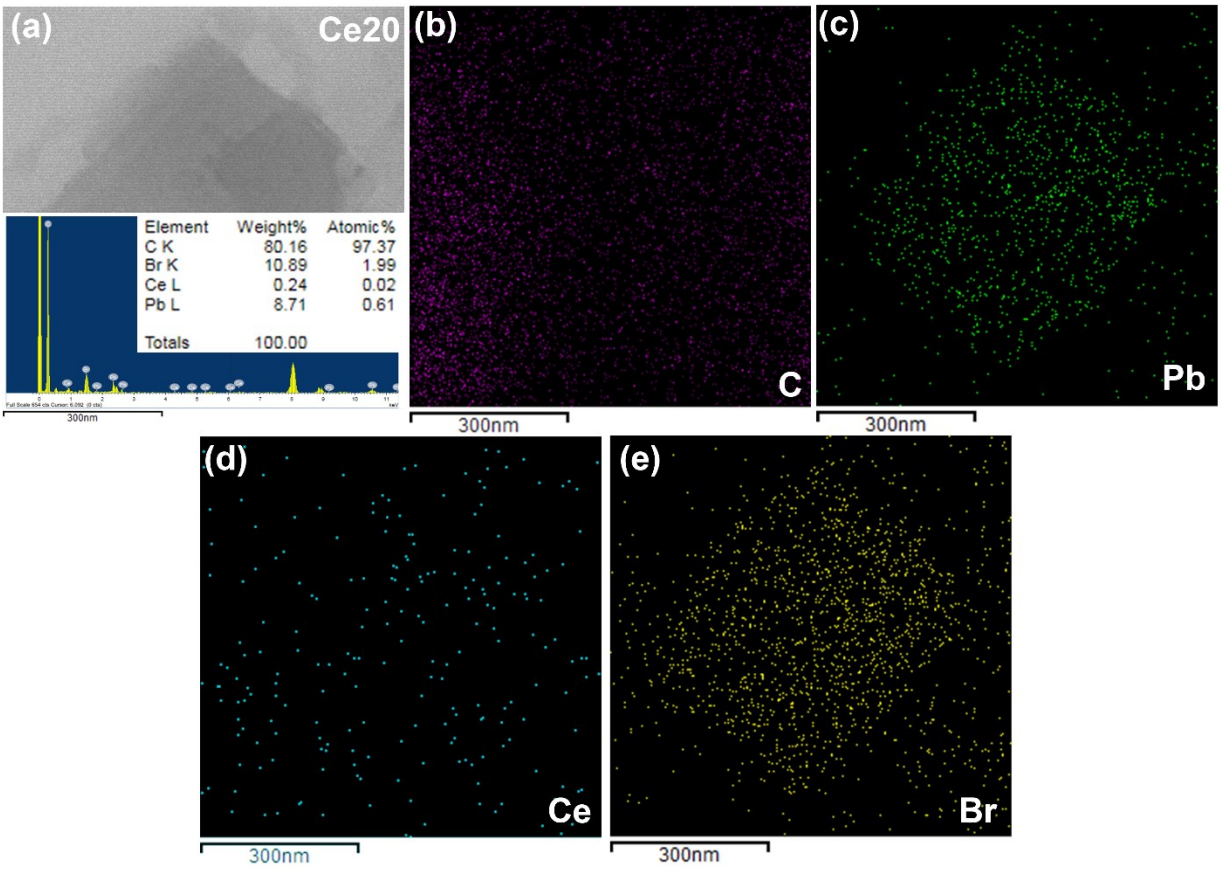

Fig. S1: (a) TEM image of Ce doped perovskite nanoplatelets in Ce20; the inset shows the corresponding EDX spectrum. (b-e) Corresponding elemental mapping images of C, Pb, Ce and Br in Ce20.

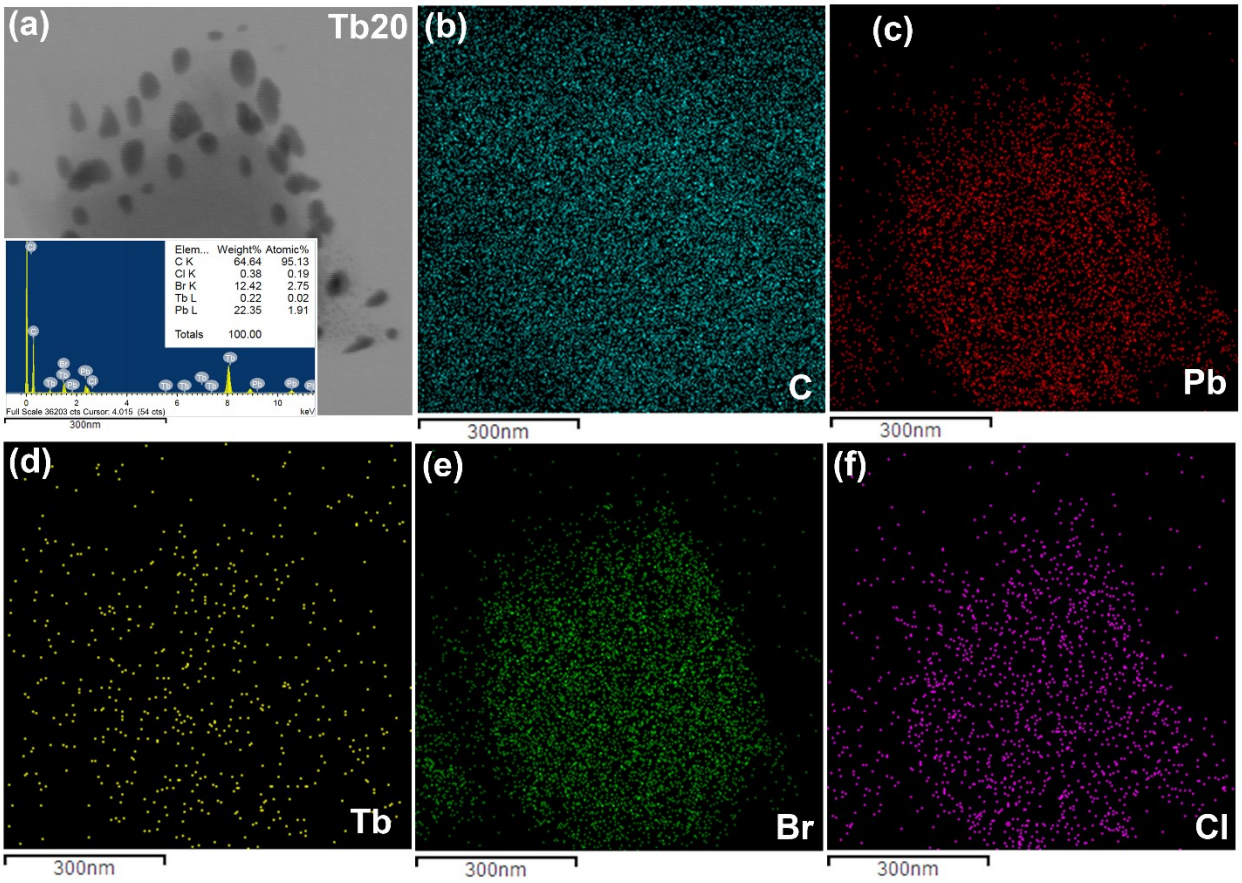

Fig. S2: (a) TEM image of Tb doped perovskite nanoplatelets in Tb20; the inset shows the corresponding EDX spectrum. (b-f) Corresponding elemental mapping images of C, Pb, Tb, Br and Cl in Tb20.

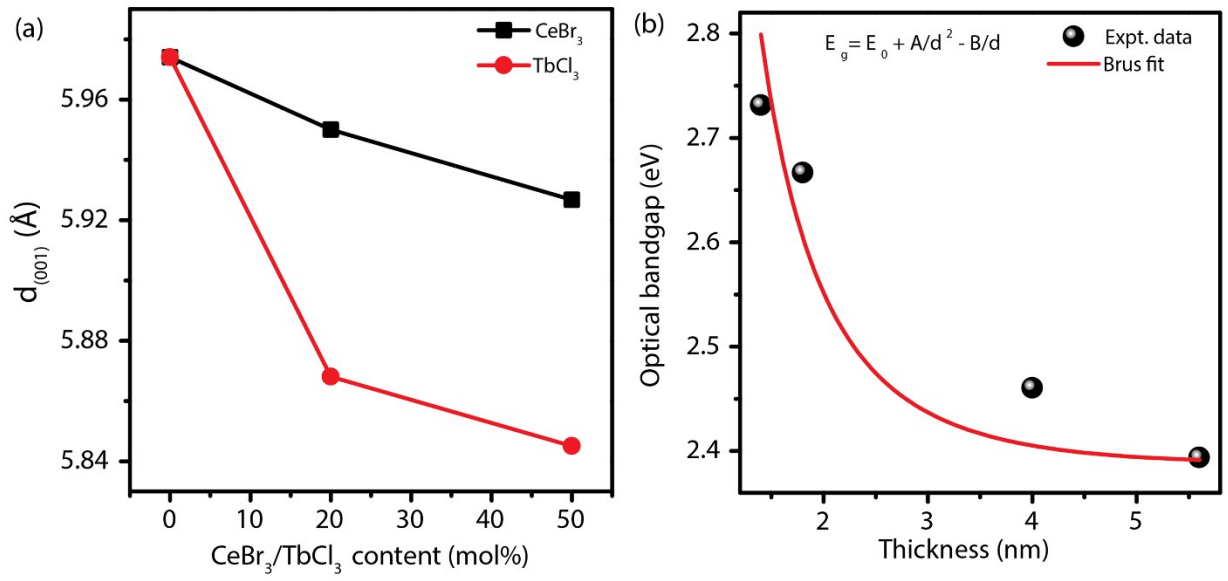

Fig. S3: (a) Change in interplanar (d_{001}) spacing with doping (Ce, Tb) concentration. (b) Variation of optical band gap with NS thickness (*d*) in Ce doped $MAPbBr_3$. The fitting (solid line) shows a poor fit with the well-known Brus equation for quantum confinement.

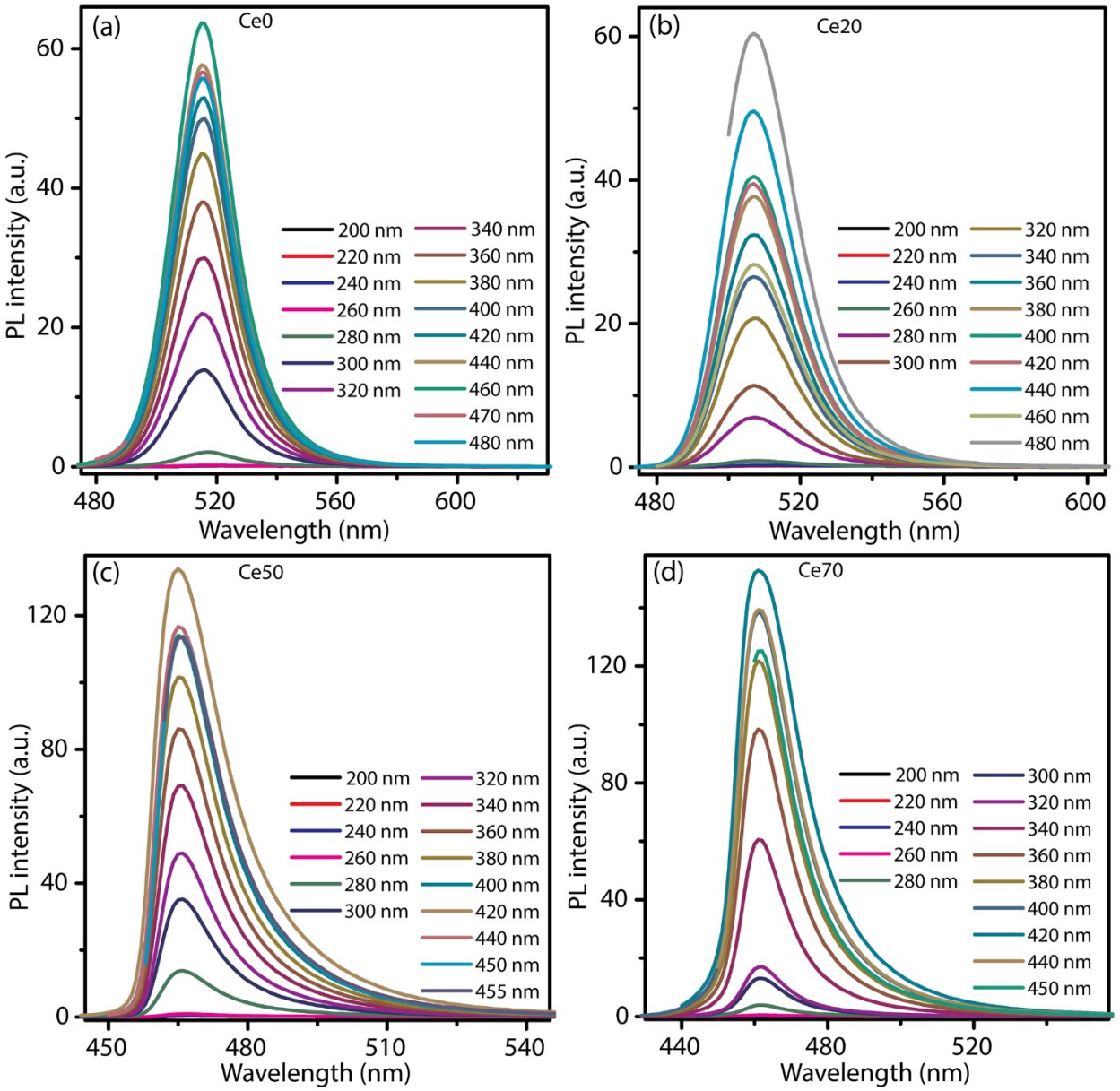

Fig. S4: Excitation wavelength dependent PL spectra of (a) Ce0, (b) Ce20, (c) Ce50 and (d) Ce70.

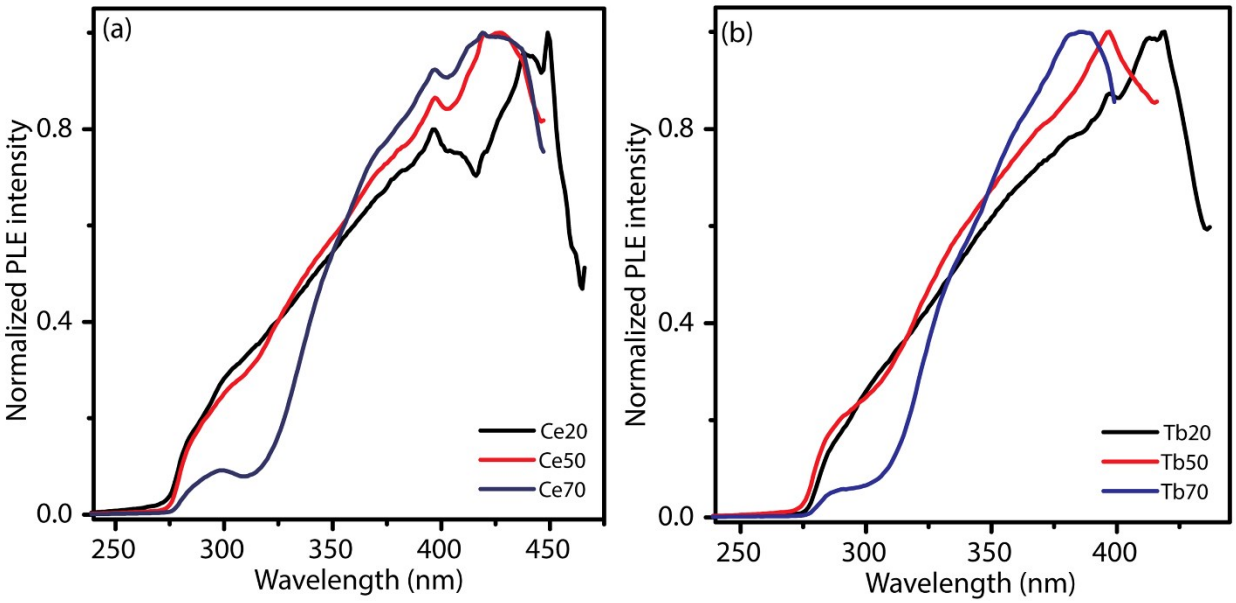

Fig. S5: Normalized PL excitation spectra of (a) Ce^{3+} and (b) Tb^{3+} doped NSs at different doping concentrations.

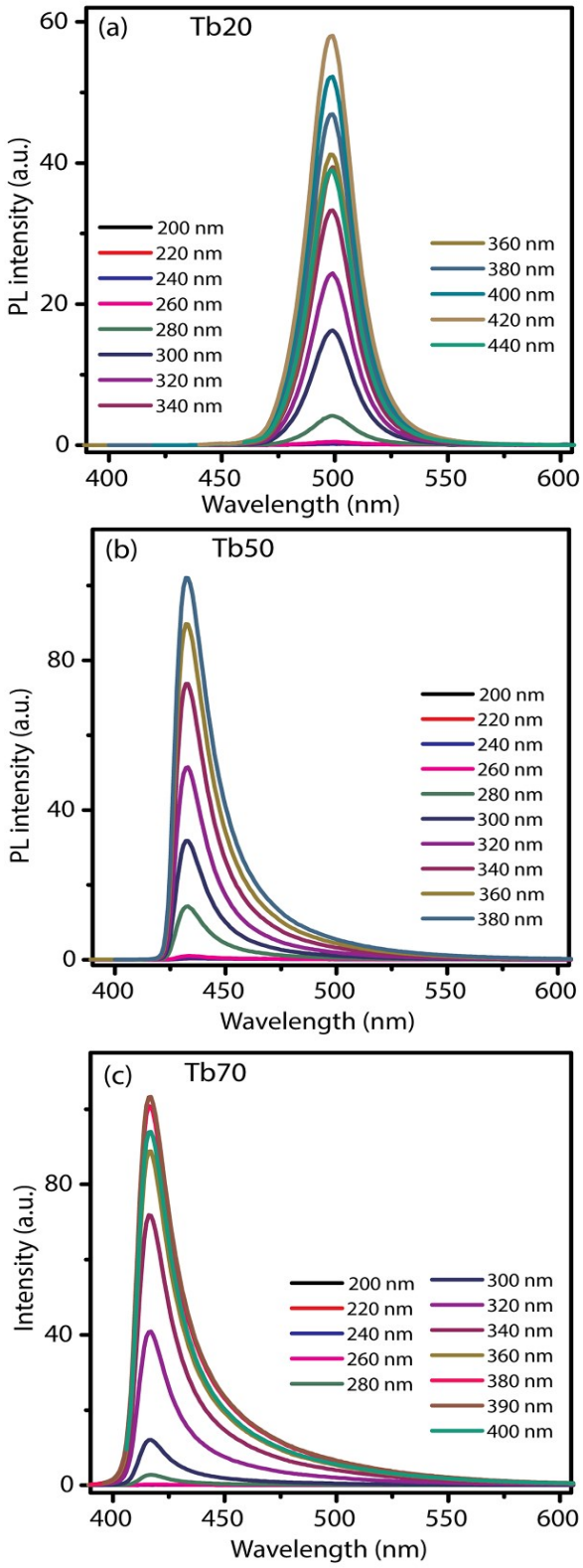

Fig. S6: Excitation wavelength dependent PL spectra of (a) Tb20, (b) Tb50 and (c) Tb70.

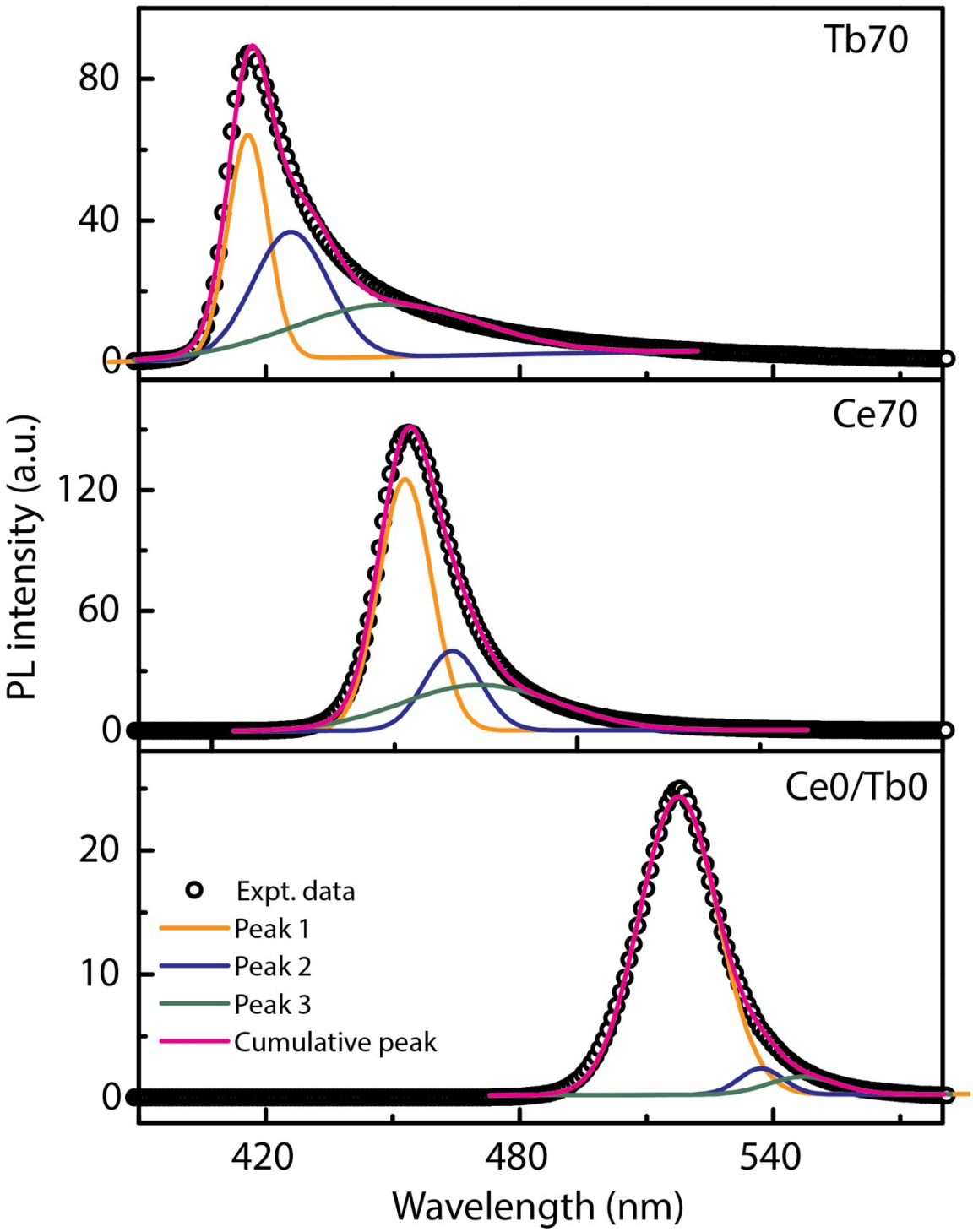

Fig. S7: Deconvulated PL spectra of Ce0, Ce70 and Tb70.

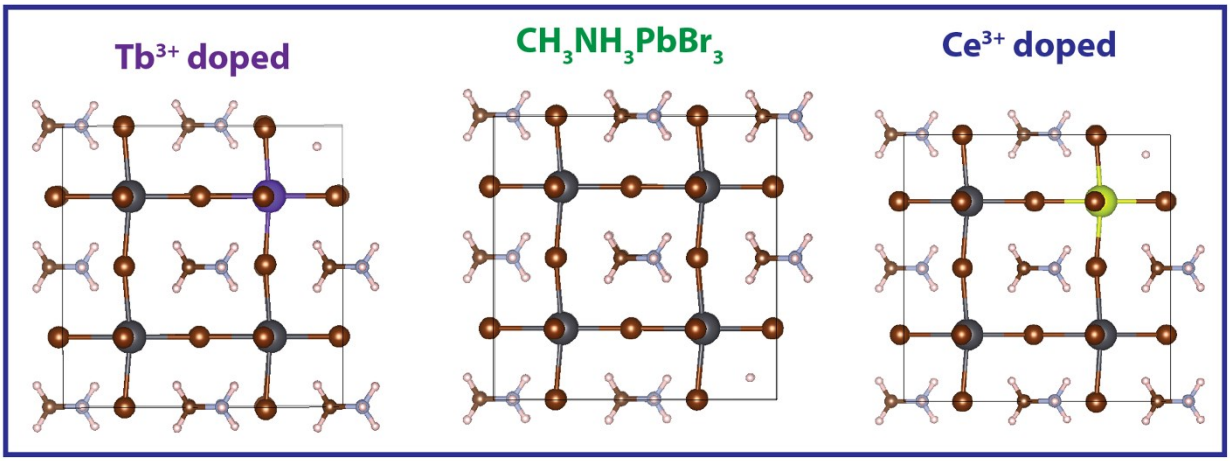

Fig. S8: Crystal structure of undoped and doped (12.5%) $CH_3NH_3PbBr_3$ perovskites taken for DFT calculations.

S1: Photoluminescence quantum yield measurement

Absolute photoluminescence quantum yield (PL QY) was measured following the instruction given in the operational manual of the instrument (FM-SPHERE, Horiba with Horiba Jibon Yvon, Fluoromax-4). The PL QY was measured using the relation:

$$\phi = \frac{E_C - E_A}{L_A - L_C} \times 100\% \qquad (1)$$

Where, E_C is the integrated luminescence of the film caused by direct excitation, E_A is the integrated luminescence from an empty integrating sphere, L_C is the integrated excitation profile when the sample is directly excited by the incident beam and L_A is the integrated excitation profile from an empty integrating sphere without the sample. To calibrate the integrating sphere, PL QY of the standard samples (Quinine sulfate, Rhodamine 101) is measured and our data matched with the literature QY. To measure the PL QY of our samples, first, the excitation (at 350 nm) intensity

with only solvent was adjusted to ~10^6 counts by adjusting the slit and neutral density filter. Afterwards, integrated excitation profile (L_A) and integrated luminescence (E_A) from an empty integrating sphere were recorded. Next, the sample was placed on the film holder inside the integrating sphere. Then, integrated excitation profile with the sample (L_C) and integrated luminescence of the sample (E_C) were recorded and corrected using the instrument correction file. Finally, the PL QY value was obtained from the instrument software.