Electronic Supplementary Information

# Tuning Optical Properties of Lead-Free 2D Tin-Based Perovskites with Carbon Chains Spacers

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**Table S1** The average layer spacing measured by XRD ($d_{1\text{-}mea}$), the layer spacing calculated by the equation d (nm) = 0.85 + 0.16 × n ($d_{2\text{-}cal}$) and the absolute value of the difference between the $d_1$ and $d_2$ ($|d_1\text{-}d_2|$).

| | $(C_8H_{17}NH_2)_2SnBr_4$ | $(C_{12}H_{25}NH_2)_2SnBr_4$ | $(C_{18}H_{37}NH_2)_2SnBr_4$ | $(OAm)_2SnBr_4$ |
|---|---|---|---|---|
| **$d_{1\text{-}mea}$ (Å)** | 20.48 | 25.87 | 28.96 | 37.47 |
| **$d_{2\text{-}cal}$ (Å)** | 21.30 | 27.70 | 37.30 | 37.30 |
| **$\|d_1\text{-}d_2\|$ (Å)** | 0.82 | 1.83 | 8.34 | 0.17 |

**Table S2** PL emission peak wavelengths, PL excitation peak wavelengths, Stokes shifts, FWHM, average decay lifetimes ($\tau_{ave}$), solid PLQYs excited by 316 nm and Tauc fit of the absorbance data (Eg) of $(RNH_2)_2SnBr_4$.

| Samples | PL peak (nm) | PLE (nm) | Stokes shifts (nm) | FWHM (nm) | $\tau_{ave}$ (μs) | PLQY (%) | Eg (eV) |
|---|---|---|---|---|---|---|---|
| **$(C_8H_{17}NH_2)_2SnBr_4$** | 612 | 361 | 251 | 130 | 3.93 | 54.25 | 3.26 |
| **$(C_{12}H_{25}NH_2)_2SnBr_4$** | 616 | 496 | 120 | 126 | 4.53 | 1.94 | 3.61 |
| **$(C_{18}H_{37}NH_2)_2SnBr_4$** | 617 | 496 | 121 | 140 | 4.48 | 1.85 | 3.56 |
| **$(OAm)_2SnBr_4$** | 628 | 346 | 282 | 156 | 4.3 | 61.08 | 3.53 |

**Table S3** XPS peak of elements Sn, Br, N for $(C_8H_{17}NH_2)_2SnBr_4$, $(C_{12}H_{25}NH_2)_2SnBr_4$, $(C_{18}H_{37}NH_2)_2SnBr_4$, respectively.

| Samples | Sn $3d_{5/2}$ (eV) | Sn $3d_{3/2}$ (eV) | Br $3d_{5/2}$ (eV) | Br $3d_{3/2}$ (eV) | N (eV) |
|---|---|---|---|---|---|
| **$(C_8H_{17}NH_2)_2SnBr_4$** | 487.20 | 495.51 | 67.36 | 68.36 | 400.99 |
| **$(C_{12}H_{25}NH_2)_2SnBr_4$** | 487.68 | 496.25 | 67.94 | 68.97 | 401.46 |
| **$(C_{18}H_{37}NH_2)_2SnBr_4$** | 487.58 | 496.03 | 67.73 | 68.78 | 401.28 |

**Table S4** Radiative lifetime ($\tau_r$) and non- radiative lifetime ($\tau_{nr}$) of $(C_8H_{17}NH_2)_2SnBr_4$, $(C_{12}H_{25}NH_2)_2SnBr_4$, $(C_{18}H_{37}NH_2)_2SnBr_4$ respectively.

| | PLQY (%) | $\tau_{ave}$ | $\tau_{nr}$ | $\tau_r$ |
|---|---|---|---|---|
| **$(C_8H_{17}NH_2)_2SnBr_4$** | 54.25 | 3.93 | 8.585 | 7.244 |
| **$(C_{12}H_{25}NH_2)_2SnBr_4$** | 1.94 | 4.53 | 4.619 | 233.505 |
| **$(C_{18}H_{37}NH_2)_2SnBr_4$** | 1.85 | 4.48 | 4.564 | 242.162 |

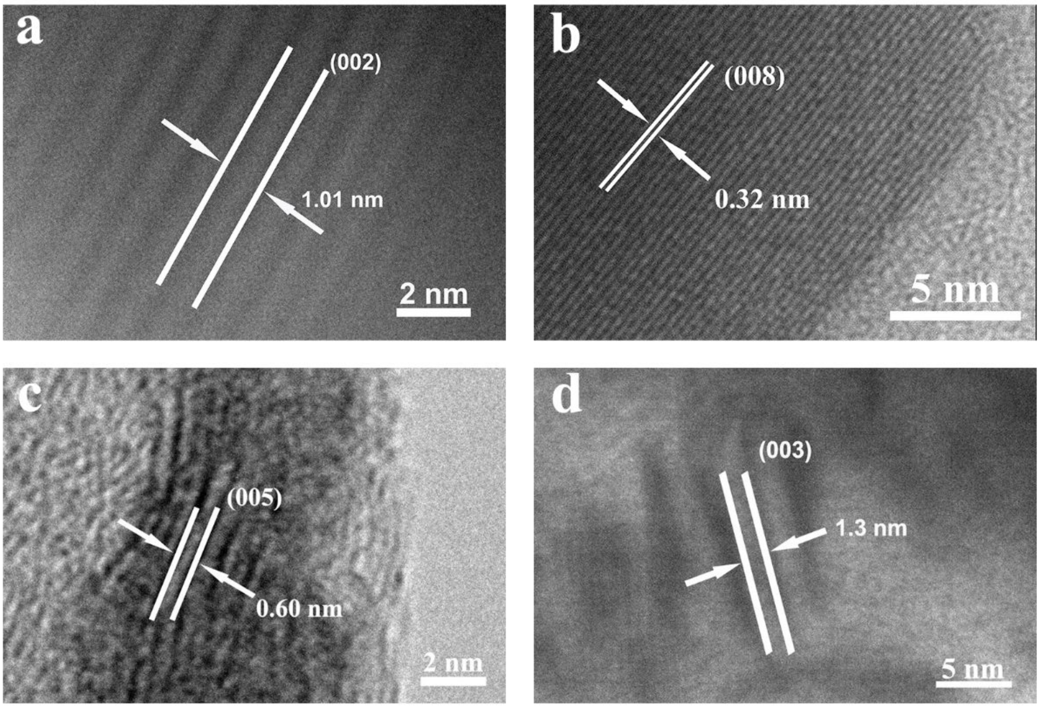


**Figure S1**. HRTEM images for (a) $(C_8H_{17}NH_2)_2SnBr_4$, (b) $(C_{12}H_{25}NH_2)_2SnBr_4$, (c) $(C_{18}H_{37}NH_2)_2SnBr_4$ and (d) $(OAm)_2SnBr_4$, respectively.

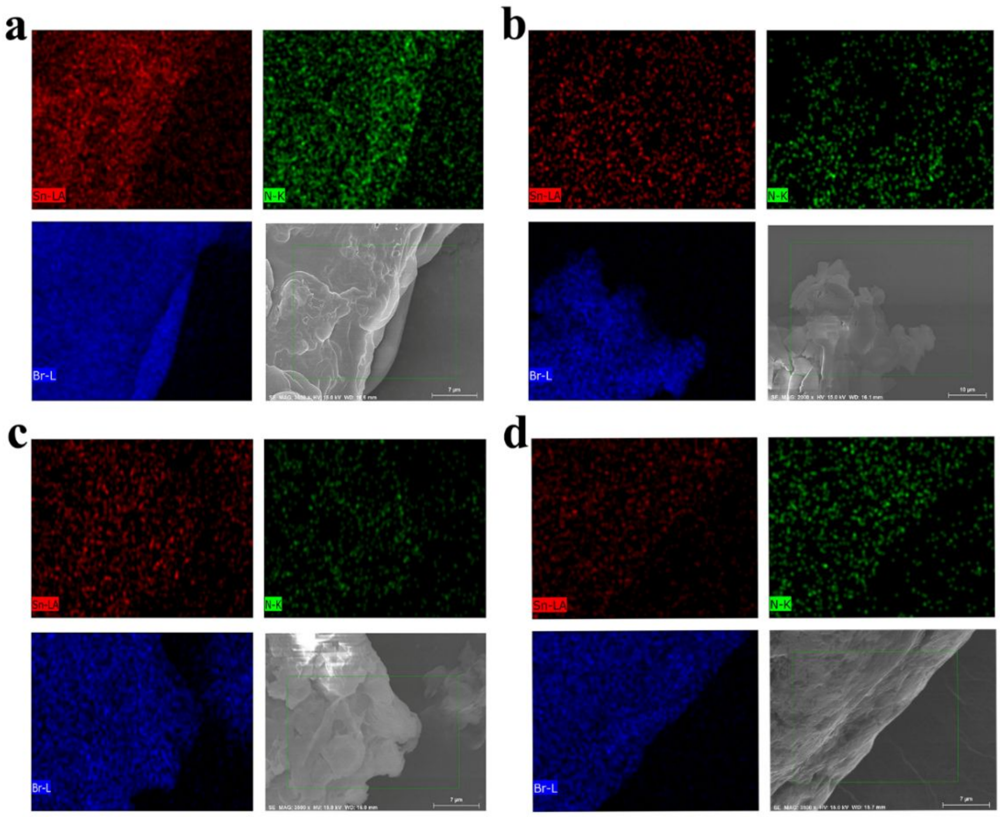


**Figure S2**. SEM and EDS mapping images for (a) $(C_8H_{17}NH_2)_2SnBr_4$, (b) $(C_{12}H_{25}NH_2)_2SnBr_4$, (c) $(C_{18}H_{37}NH_2)_2SnBr_4$ and (d) $(OAm)_2SnBr_4$, respectively.

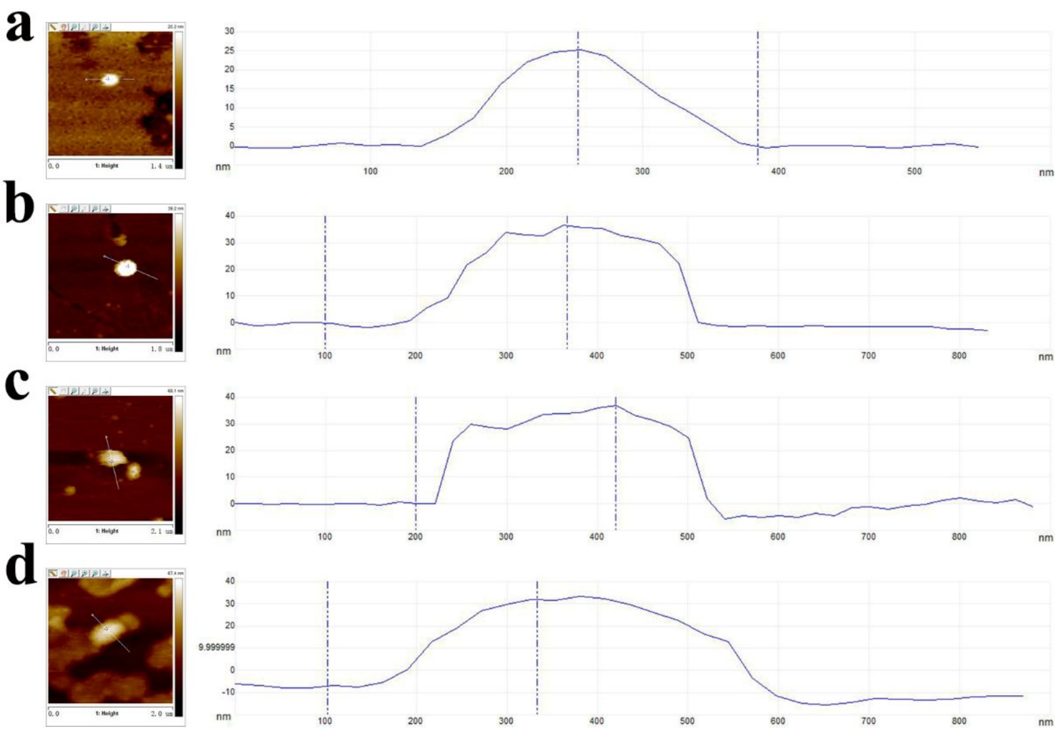

**Figure S3**. AFM images for (a) $(C_8H_{17}NH_2)_2SnBr_4$, (b) $(C_{12}H_{25}NH_2)_2SnBr_4$, (c) $(C_{18}H_{37}NH_2)_2SnBr_4$ and (d) $(OAm)_2SnBr_4$, respectively.