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


# Supporting information

## Highly luminescent broadband phosphors based on acid solvent coordinated two-dimensional layered tin-based perovskites

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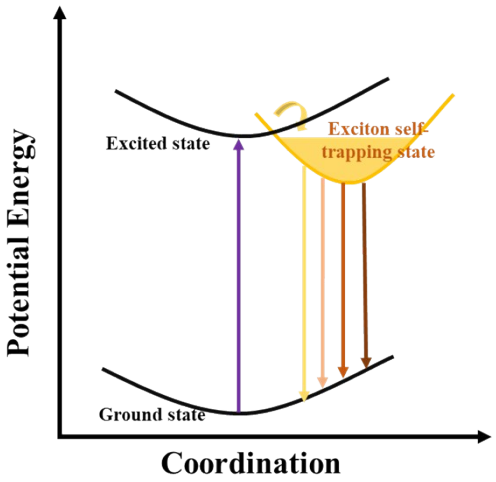


Fig. S1 Schematic of the process of emission from the exciton self-trapping state.

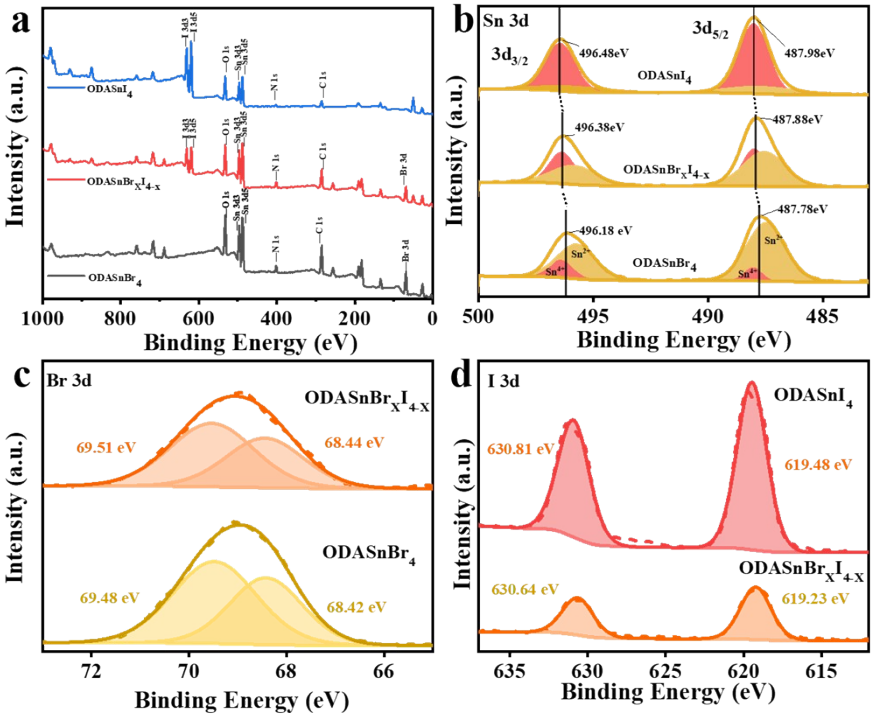


Fig. S2 X-ray photoelectron spectroscopy (XPS) of $ODASnBr_4$, $ODASnBr_xI_{4-x}$ and $ODASnI_4$. (a) survey spectra of $ODASnBr_4$, $ODASnBr_xI_{4-x}$ and $ODASnI_4$; XPS spectra of (b) Sn3d, (c) Br3d, and (d) I3d core levels.

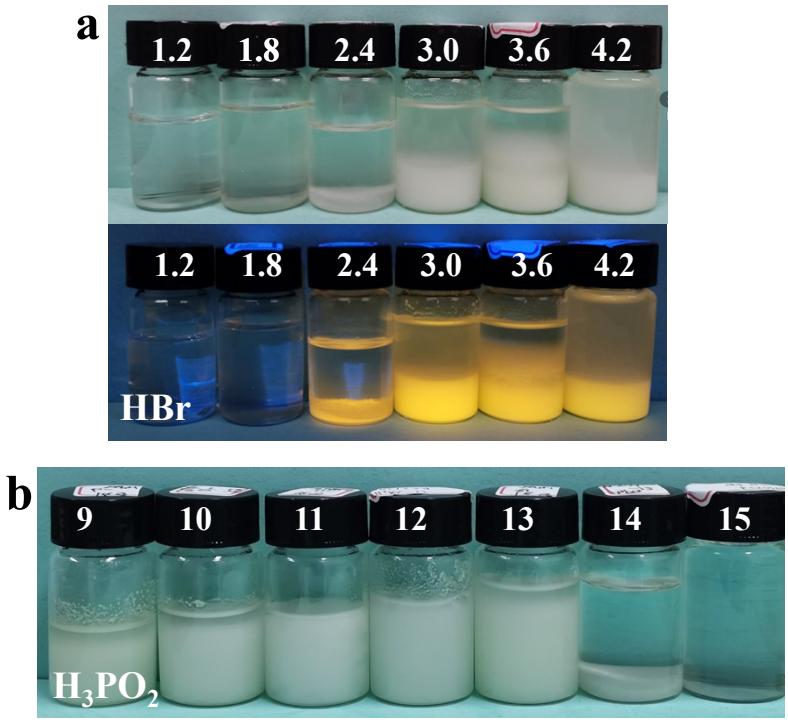


Fig. S3 Photographs of the $ODASnBr_4$ suspension synthesized by different volumes of (a) HBr and (b) $H_3PO_2$ respectively.

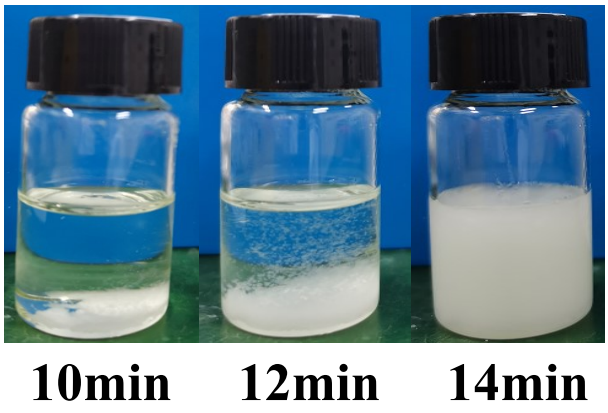


Fig. S4 The production process of sample with $H_3PO_2$ of 13 mL. The time at the bottom of the picture represents the time after the solution cooled naturally from 80 °C.

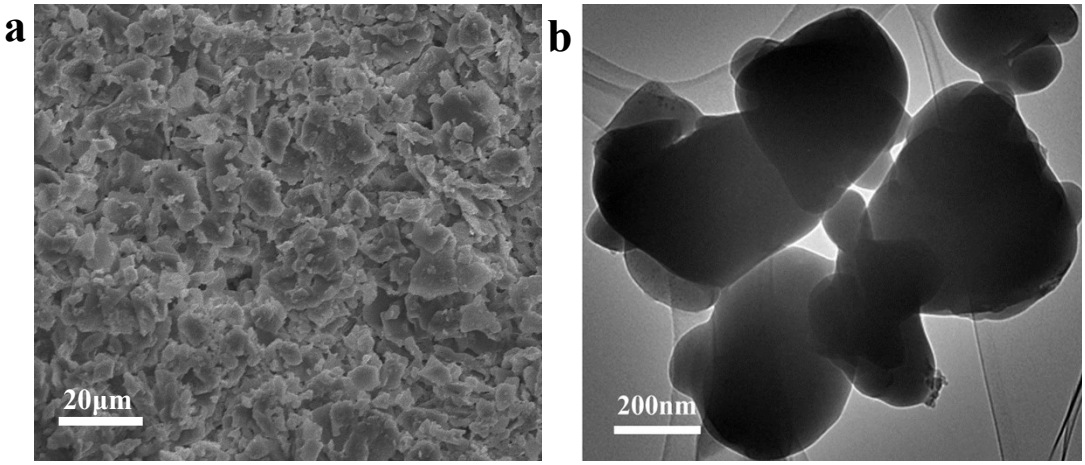


Fig. S5 (a) SEM images and (b) TEM images of $ODASnBr_4$ (samples HBr 3.0 mL).

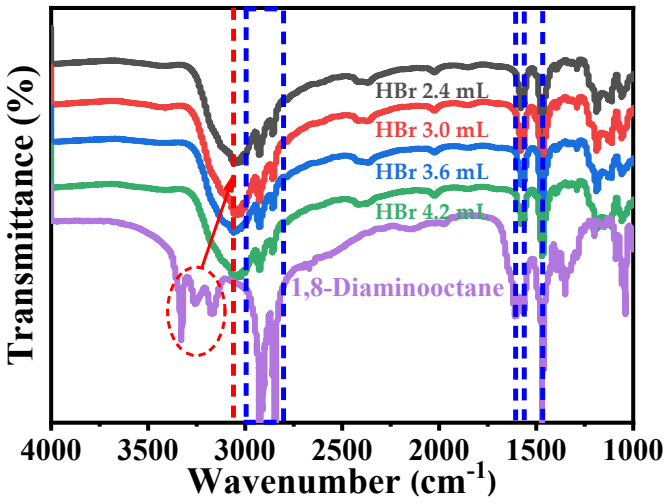


Fig. S6 FTIR spectra of $ODASnBr_4$ perovskite and the reactants used in its synthesis.

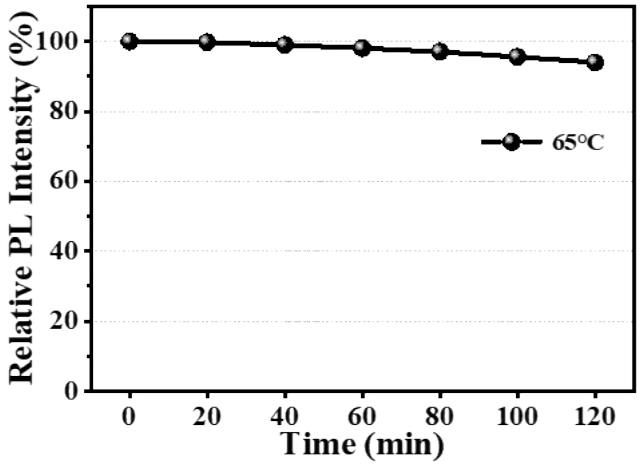


Fig. S7 Relative PL intensity of $ODASnBr_4$ at 65 °C for 120 mins.

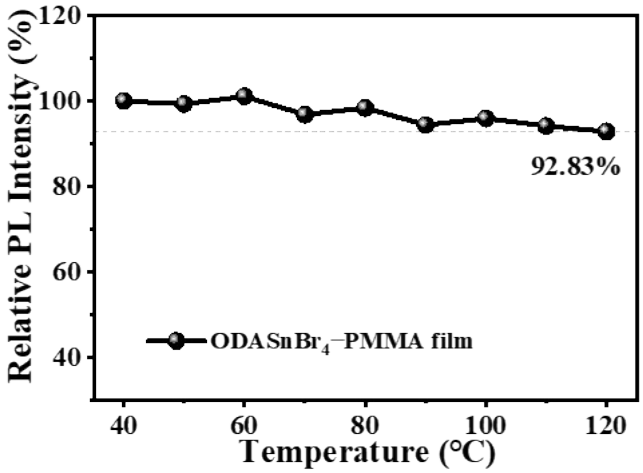


Fig. S8 Relative PL intensity of $ODASnBr_4$–PMMA film heat from 40 to 120 °C.

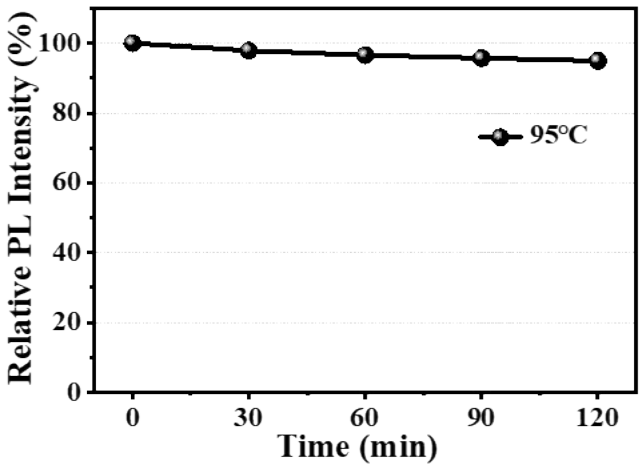


Fig. S9 Relative luminance efficiency of film at 95 °C for 120 min.

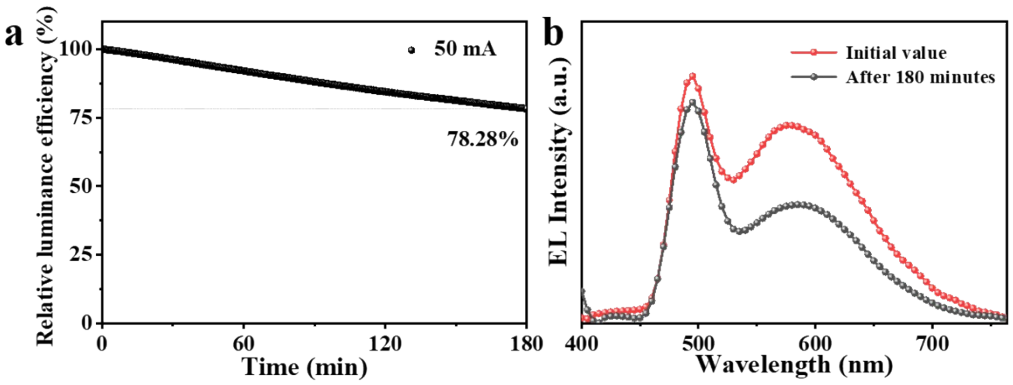


Fig. S10 (a) Relative luminance efficiency of as-fabricated WLEDs and (b) EL spectra of different times.

Table S1. The comparison of the XRD with other reported results.

| Chemical formula | 2θ/° | | | Ref. |
|---|---|---|---|---|
| | (0 0 2) | (0 0 4) | (0 0 8) | |
| $ODASnBr_4$ | 6.20 | 12.47 | 24.77 | S1 |
| $ODASnBr_4$[2%-DCM] | 6.18 | 12.42 | - | S1 |
| $ODASnBr_4$[2%-CFM] | 6.13 | 12.30 | 23.7 | S1 |
| $ODASnBr_4$ | 6.71 | 13.40 | - | S2 |
| Calculated $ODASnBr_4$ | 6.56 | 13.15 | - | S2 |
| $ODASnBr_4$[EtOH] | 6.70 | 13.36 | 29.9 | S2 |
| $ODASnBr_4$[PrOH] | 6.41 | 12.80 | - | S2 |
| $ODASnBr_4$[BuOH] | 6.45 | 12.86 | - | S2 |
| $ODASnBr_4$[PeOH] | 6.42 | 12.80 | - | S2 |
| $ODASnBr_4$[alcohol] | 6.12-6.28 | - | - | S3 |
| $ODASnBr_4$ | 6.36 | 12.72 | 25.44 | This work |

Table S2. Comparison of microstructure and spectroscopic properties of $ODASnBr_4$.

| Chemical formula | Experiment method | Microstructure | Spectroscopic properties | | | Ref. |
|---|---|---|---|---|---|---|
| | | | PL peak (nm) | PLQY (%) | τ (μs) | |
| $ODASnBr_4$[2% CFM] | ligand assisted re-precipitation method followed by CFM/DCM treatment | spherical microcrystals | 570-598 | 88 ± 4 | >2.4 | S1 |
| $ODASnBr_4$[2% DCM] | | | 592-608 | 83 ± 4 | >2.9 | |
| $ODASnBr_4$[EtOH] | argon gas assisted saturation recrystallization method followed by grinding with different alcohol dopants | irregular layered structure (20-50 nm) | 616 | 86 | 3.61 | S2 |
| $ODASnBr_4$[PrOH] | | regular layered structure (>100 nm) | 611 | 83 | 3.37 | |
| $ODASnBr_4$[BuOH] | | crumby structure | 613 | 87 | 3.24 | |
| $ODASnBr_4$[PeOH] | | crumby structure | 615 | 87 | 3.32 | |
| $ODASnBr_4$[alcohol] | wet milling method | 2D sheet | 572-601 | 88±1 | >2.9 | S3 |
| $ODASnBr_4$ | saturation recrystallization method in ambient environment | flake microcrystals (5-20 μm) | 586 | 98.22 | 3.166 | This work |

Table S3. The performance parameter of the as-fabricated WLEDs.

| LED | drive current (mA) | luminous flux (lm) | luminance efficiency (lm/W) | CRI | color coordinate |
|---|---|---|---|---|---|
| Blue: Yellow = 1:2 | 50 | 0.9612 | 6.408 | 89.4 | (0.3421, 0.3384) |
| Blue: Yellow = 1:2 | 60 | 1.1817 | 6.565 | 89.9 | (0.3429, 0.3466) |
| Blue: Yellow = 1:2 | 70 | 1.4036 | 6.684 | 90.3 | (0.3439, 0.3526) |
| Blue: Yellow = 1:2 | 80 | 1.6341 | 6.808 | 90.3 | (0.3452, 0.3547) |
| Blue: Yellow = 1:2 | 90 | 1.8650 | 6.908 | 90.1 | (0.3466, 0.3614) |
| Blue: Yellow = 1:4 | 50 | 0.9744 | 6.496 | 86.1 | (0.3227, 0.3209) |
| Blue: Yellow = 1:4 | 60 | 1.1872 | 6.596 | 86.5 | (0.3212, 0.3228) |
| Blue: Yellow = 1:4 | 70 | 1.4084 | 6.707 | 86.9 | (0.3198, 0.3250) |
| Blue: Yellow = 1:4 | 80 | 1.6457 | 6.857 | 87.4 | (0.3162, 0.3291) |
| Blue: Yellow = 1:4 | 90 | 1.8722 | 6.934 | 87.1 | (0.3134, 0.3352) |

**References:**


S1. S. Wang, J. Popović, S. Burazer, A. Portniagin, F. Liu, K. Low, Z. Duan, Y. Li, Y. Xiong, Y. Zhu, S. V Kershaw, A. B. Djurišić and A. L. Rogach, Adv. Funct. Mater. 2021, 31, 2102182.

S2. S. Wang, S. V Kershaw and A. L. Rogach, Chem. Mater., 2021, 33, 5413-5421.

S3. J. Qi, S. Wang, A. Portniagin, S. V Kershaw and A. L. Rogach, Nanomaterials, 2021, 11, 2738-2748.