**Electronic Supplementary Information (ESI) for Dalton Transactions**

# Facile synthesis of $Sb^{3+}$:$(Bmim)_2InCl_5(H_2O)$ through a grinding method for light-emitting diodes

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## Supporting Tables

**Table S1. The single crystal X-ray diffraction data of $(Bmim)_2InCl_5(H_2O)$**

| Empirical formula | $C_{16}H_{32}Cl_5InN_4O$ |
|---|---|
| Formula weight | 588.52 |
| Temperature/K | 173 |
| Crystal system | monoclinic |
| Space group | $P2_1/n$ |
| a/Å | 8.7805(3) |
| b/Å | 13.8362(5) |
| c/Å | 21.0836(8) |
| α/° | 90 |
| β/° | 96.1830(10) |
| γ/° | 90 |
| Volume/Å$^3$ | 2546.52(16) |
| Z | 4 |
| $\rho_{calc}$g / cm$^3$ | 1.535 |
| μ / mm$^{-1}$ | 1.466 |
| Radiation | Mo Kα (λ = 0.71073) |
| Reflections collected | 74745 |
| Goodness of fit on $F^2$ | 1.078 |
| Final R indexes [I > = 2σ (I)] | $R_1$ = 0.0304, $wR_2$ = 0.0640 |
| Final R indexes [all data] | $R_1$ = 0.0387, $wR_2$ = 0.0679 |

**Table S2. Bond lengths of $(Bmim)_2InCl_5(H_2O)$**

| bond | lengths (Å) | bond | lengths (Å) |
|---|---|---|---|
| In1-Cl1 | 2.4753(6) | N3-C11 | 1.382(3) |
| In1-Cl2 | 2.5441(5) | N3-C13 | 1.472(3) |
| In1-Cl4 | 2.5368(5) | N4-C9 | 1.462(3) |
| In1-Cl5 | 2.4825(5) | N4-C10 | 1.326(3) |
| In1-Cl6 | 2.4518(6) | N4-C12 | 1.382(3) |
| In1-O1 | 2.2984(15) | C9-H9A | 0.9800 |
| O1-H1D | 0.8695 | C9-H9B | 0.9800 |
| O1-H1E | 0.8701 | C9-H9C | 0.9800 |
| N1-C3 | 1.374(3) | C10-H10 | 0.9500 |
| N1-C4 | 1.329(3) | C11-H11 | 0.9500 |
| N1-C5 | 1.473(3) | C11-C12 | 1.346(4) |
| N2-C1 | 1.466(3) | C12-H12 | 0.9500 |
| N2-C2 | 1.370(3) | C13-H13A | 0.9900 |
| N2-C4 | 1.322(3) | C13-H13B | 0.9900 |
| C1-H1A | 0.9800 | C13-C14 | 1.516(5) |
| C1-H1B | 0.9800 | C14-H14C | 0.9900 |
| C1-H1C | 0.9800 | C14-H14D | 0.9900 |
| C2-H2 | 0.9500 | C14-H14A | 0.9900 |
| C2-C3 | 1.345(4) | C14-H14B | 0.9900 |
| C3-H3 | 0.9500 | C14-C17 | 1.360(9) |
| C4-H4 | 0.9500 | C14-C15 | 1.296(7) |
| C5-H5A | 0.9900 | C17-H17A | 0.9900 |
| C5-H5B | 0.9900 | C17-H17B | 0.9900 |
| C5-C6 | 1.514(4) | C17-C18 | 1.850(15) |
| C6-H6A | 0.9900 | C18-H18A | 0.9800 |
| C6-H6B | 0.9900 | C18-H18B | 0.9800 |
| C6-C7 | 1.528(4) | C18-H18C | 0.9800 |

| | | | |
|---|---|---|---|
| C7-H7A | 0.9900 | C15-H15A | 0.9900 |
| C7-H7B | 0.9900 | C15-H15B | 0.9900 |
| C7-C8 | 1.507(5) | C15-C16 | 1.956(13) |
| C8-H8A | 0.9800 | C16-H16A | 0.9800 |
| C8-H8B | 0.9800 | C16-H16B | 0.9800 |
| C8-H8C | 0.9800 | C16-H16C | 0.9800 |
| N3-C10 | 1.331(3) | | |

**Table S3. Bond angles of $(Bmim)_2InCl_5(H_2O)$**

| Atom | Angle / º | Atom | Angle / º |
|---|---|---|---|
| Cl1-In1-Cl2 | 87.325(19) | C10-N3-C11 | 108.5(2) |
| Cl1-In1-Cl4 | 171.70(2) | C10-N3-C13 | 126.2(2) |
| Cl1-In1-Cl5 | 92.21(2) | C11-N3-C13 | 125.3(2) |
| Cl4-In1-Cl2 | 89.860(17) | C10-N4-C9 | 125.9(2) |
| Cl5-In1-Cl2 | 165.768(19) | C10-N4-C12 | 108.6(2) |
| Cl5-In1-Cl4 | 88.606(18) | C12-N4-C9 | 125.5(2) |
| Cl6-In1-Cl1 | 94.47(2) | N4-C9-H9A | 109.50 |
| Cl6-In1-Cl2 | 96.03(2) | N4-C9-H9B | 109.50 |
| Cl6-In1-Cl4 | 93.59(2) | N4-C9-H9C | 109.50 |
| Cl6-In1-Cl5 | 98.19(2) | H9A-C9-H9B | 109.50 |
| O1-In1-Cl1 | 86.33(4) | H9A-C9-H9C | 109.50 |
| O1-In1-Cl2 | 82.02(4) | H9B-C9-H9C | 109.50 |
| O1-In1-Cl4 | 85.54(4) | N3-C10-H10 | 125.60 |
| O1-In1-Cl5 | 83.76(4) | N4-C10-N3 | 108.8(2) |
| O1-In1-Cl6 | 177.86(4) | N4-C10-H10 | 125.60 |
| In1-O1-H1D | 109.30 | N3-C11-H11 | 126.50 |
| In1-O1-H1E | 109.40 | C12-C11-N3 | 107.1(2) |
| H1D-O1-H1E | 104.50 | C12-C11-H11 | 126.50 |
| C3-N1-C5 | 125.8(2) | N4-C12-H12 | 126.40 |
| C4-N1-C3 | 108.40(19) | C11-C12-N4 | 107.2(2) |
| C4-N1-C5 | 125.76(19) | C11-C12-H12 | 126.40 |
| C2-N2-C1 | 125.1(2) | N3-C13-H13A | 109.40 |
| C4-N2-C1 | 126.6(2) | N3-C13-H13B | 109.40 |
| C4-N2-C2 | 108.3(2) | N3-C13-C14 | 111.0(3) |
| N2-C1-H1A | 109.50 | H13A-C13-H13B | 108.00 |
| N2-C1-H1B | 109.50 | C14-C13-H13A | 109.40 |
| N2-C1-H1C | 109.50 | C14-C13-H13B | 109.40 |

| | | | |
|---|---|---|---|
| H1A-C1-H1B | 109.50 | C13-C14-H14C | 103.60 |
| H1A-C1-H1C | 109.50 | C13-C14-H14D | 103.60 |
| H1B-C1-H1C | 109.50 | C13-C14-H14A | 107.90 |
| N2-C2-H2 | 126.20 | C13-C14-H14B | 107.90 |
| C3-C2-N2 | 107.6(2) | H14C-C14-H14D | 105.30 |
| C3-C2-H2 | 126.20 | H14A-C14-H14B | 107.20 |
| N1-C3-H3 | 126.60 | C17-C14-C13 | 134.3(6) |
| C2-C3-N1 | 106.8(2) | C17-C14-H14C | 103.60 |
| C2-C3-H3 | 126.60 | C17-C14-H14D | 103.60 |
| N1-C4-H4 | 125.60 | C15-C14-C13 | 117.8(4) |
| N2-C4-N1 | 108.88(19) | C15-C14-H14A | 107.90 |
| N2-C4-H4 | 125.60 | C15-C14-H14B | 107.90 |
| N1-C5-H5A | 109.10 | C14-C17-H17A | 113.10 |
| N1-C5-H5B | 109.10 | C14-C17-H17B | 113.10 |
| N1-C5-C6 | 112.4(2) | C14-C17-C18 | 92.9(6) |
| H5A-C5-H5B | 107.90 | H17A-C17-H17B | 110.50 |
| C6-C5-H5A | 109.10 | C18-C17-H17A | 113.10 |
| C6-C5-H5B | 109.10 | C18-C17-H17B | 113.10 |
| C5-C6-H6A | 109.00 | C17-C18-H18A | 109.50 |
| C5-C6-H6B | 109.00 | C17-C18-H18B | 109.50 |
| C5-C6-C7 | 113.1(2) | C17-C18-H18C | 109.50 |
| H6A-C6-H6B | 107.80 | H18A-C18-H18B | 109.50 |
| C7-C6-H6A | 109.00 | H18A-C18-H18C | 109.50 |
| C7-C6-H6B | 109.00 | H18B-C18-H18C | 109.50 |
| C6-C7-H7A | 109.10 | C14-C15-H15A | 112.10 |
| C6-C7-H7B | 109.10 | C14-C15-H15B | 112.10 |
| H7A-C7-H7B | 107.80 | C14-C15-C16 | 98.4(5) |
| C8-C7-C6 | 112.7(3) | H15A-C15-H15B | 109.70 |
| C8-C7-H7A | 109.10 | C16-C15-H15A | 112.10 |

| | | | |
|---|---|---|---|
| C8-C7-H7B | 109.10 | C16-C15-H15B | 112.10 |
| C7-C8-H8A | 109.50 | C15-C16-H16A | 109.50 |
| C7-C8-H8B | 109.50 | C15-C16-H16B | 109.50 |
| C7-C8-H8C | 109.50 | C15-C16-H16C | 109.50 |
| H8A-C8-H8B | 109.50 | H16A-C16-H16B | 109.50 |
| H8A-C8-H8C | 109.50 | H16A-C16-H16C | 109.50 |
| H8B-C8-H8C | 109.50 | | |

**Table S4. ICP-OES data of Sb:$(Bmim)_2InCl_5(H_2O)$**

| Feeding ratio (%) | | Actual ratio (%) | |
|---|---|---|---|
| In | Sb | In | Sb |
| 80 | 20 | 94.26 | 5.74 |
| 85 | 15 | 97.38 | 2.62 |
| 90 | 10 | 99.14 | 0.86 |
| 95 | 5 | 99.28 | 0.72 |
| 99 | 1 | 99.82 | 0.18 |

**Supporting Figure**

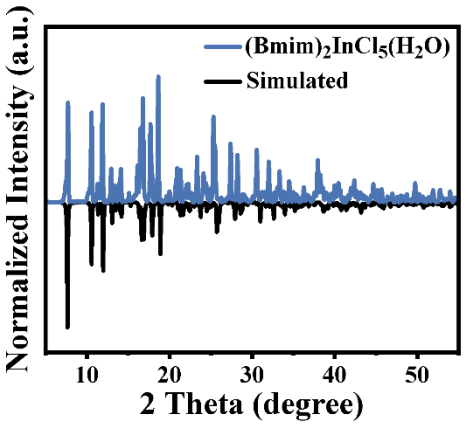


**Fig. S1** The simulated and the experimentally obtained PXRD patterns of $(Bmim)_2InCl_5(H_2O)$.

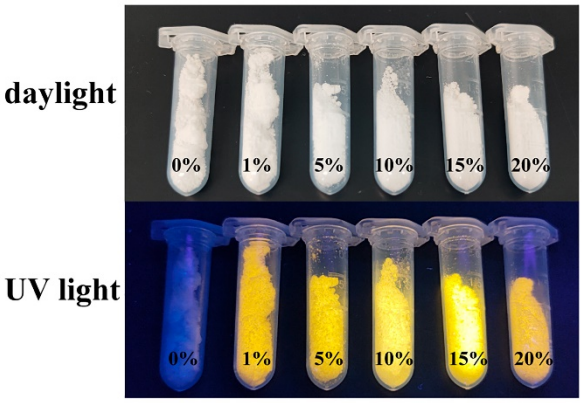


**Fig. S2** Photographs of x%$Sb^{3+}$:$(Bmim)_2InCl_5(H_2O)$ (x = 0, 1, 5, 10, 15, 20) powder under daylight (top) and UV light (bottom).