Electronic Supplementary Material (ESI) for CrystEngComm.

Centimeter-Size Square 2D Layered Pb-Free Hybrid Perovskite Single Crystal $(CH_3NH_3)_2MnCl_4$ for Red Photoluminescence

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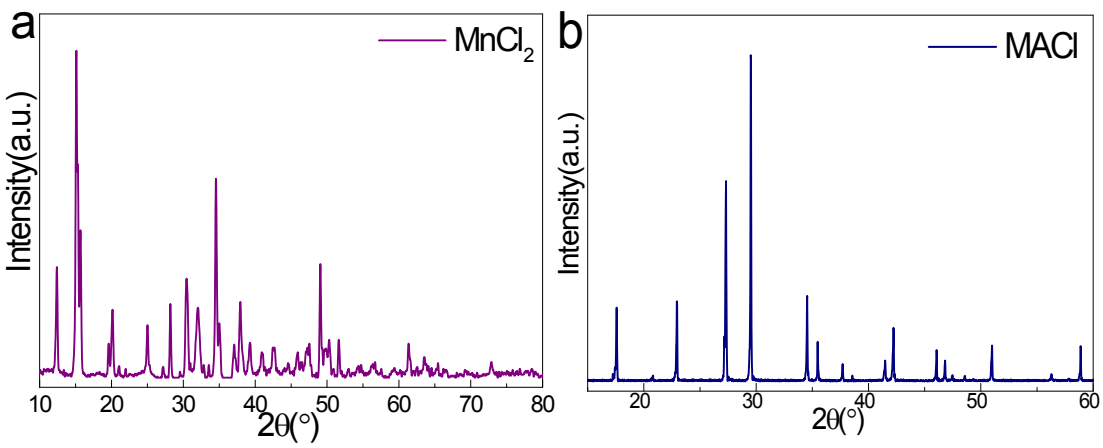

Figure S1 (a-b) the powder XRD patterns of $MnCl_2$ and MACl as solute materials

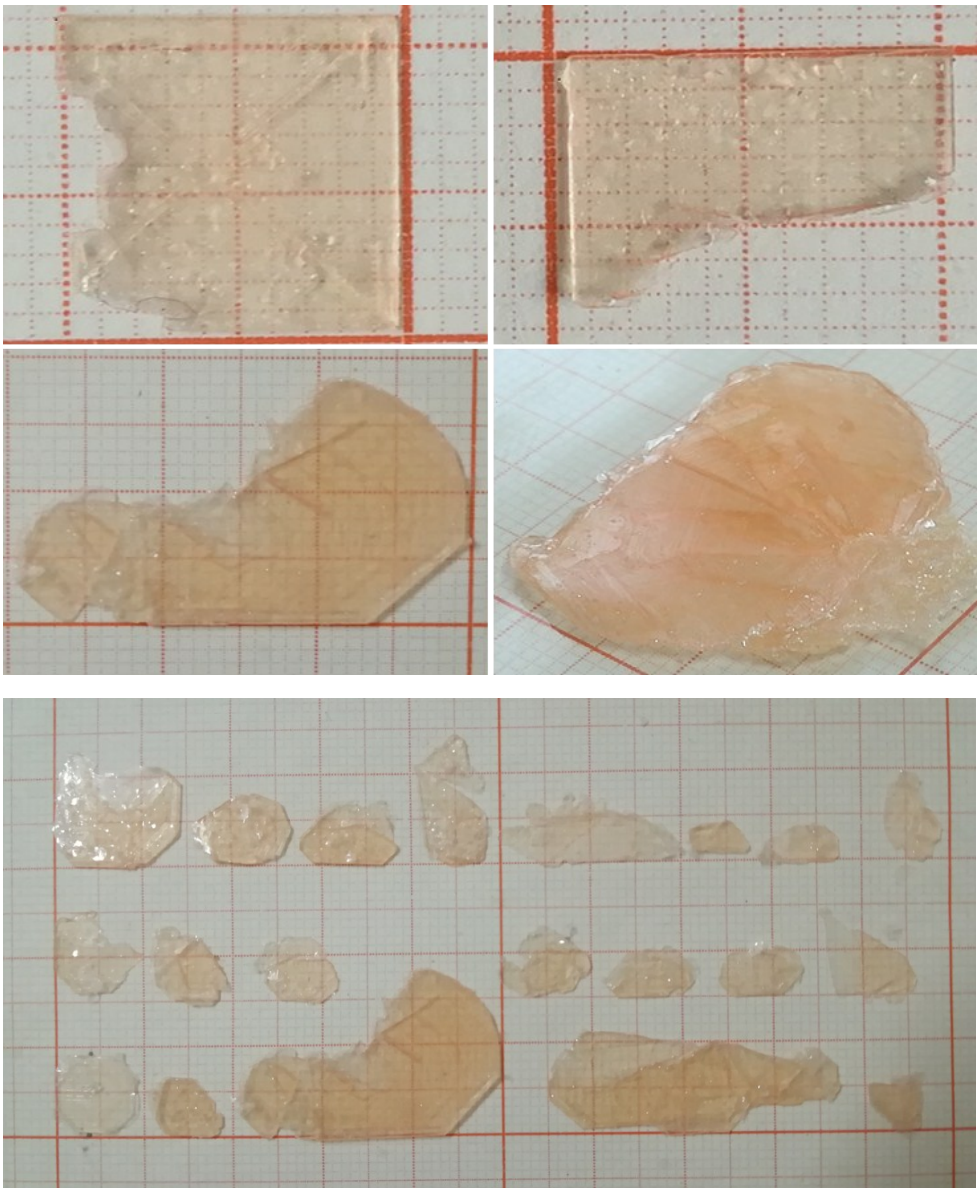

Figure S2 the photographs of $(CH_3NH_3)_2MnCl_4$ single crystals in the progress of growing

All the crystal photographs exhibited in the Figure S2 manifested that $(CH_3NH_3)_2MnCl_4$ single crystal grow in two-dimension along plane. During the $(CH_3NH_3)_2MnCl_4$ single crystal growth process, some crystals with incomplete growth were exposed, showing crystal growth along axis *a* and *b*, which was consistent with the cell parameters.

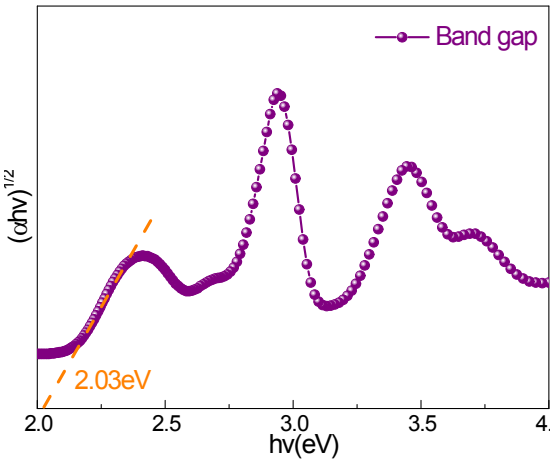

Figure S3 the optical band gap of $(CH_3NH_3)_2MnCl_4$ single crystal