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

Supporting Information

Highly Emissive Sb^{3+}-doped $Rb_2InCl_5·H_2O$ perovskites: Cost-effective Synthesis, Luminescence, and its Application

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Table S1 Main parameters of the xSb^{3+}:$Rb_2InCl_5 \cdot H_2O$ perovskites.

xSb^{3+}:$Rb_2InCl_5 \cdot H_2O$	Cell parameters (Å)			Cell volume (Å^3)
	a	b	c	
0%	14.1861	9.8878	7.3153	1026.11
5%	14.1911	9.9128	7.3065	1027.83
10%	14.1801	9.9198	7.3105	1028.32
20%	14.1769	9.9208	7.3150	1028.83
30%	14.1879	9.9211	7.3071	1028.54
40%	14.2049	9.9079	7.3144	1029.43
50%	14.2178	9.8790	7.3383	1030.72
60%	14.2212	9.8891	7.3361	1031.71

Table S2 Summary of the important parameters of red-emission lead-free perovskites.

Compounds	Doping Ions	Emission Peak	PLQYs	Experimental Method	Reference
$Cs_2NaInCl_6$	Mn^{2+}	610 nm	16%	Hydrothermal Method	54
	Mn^{2+}	610 nm	5%		65
$Cs_2AgInCl_6$	Mn^{2+}	632 nm	3-5%	Precipitation Method	58
	Mn^{2+}	620 nm	16%	Hot-injection Method	61
$Cs_2NaBiCl_6$	Mn^{2+}	590 nm	15%	Solution Method	27
	Ag^{+}	613 nm	20%	Hot-injection Method	64
	Mn^{2+}	585 nm	3.9%		
	Eu^{3+}	591 nm, 615 nm	3.3%		
$Cs_2NaIn_xBi_{1-x}Cl_6$	Mn^{2+}	614 nm	44.6%	Hot-injection Method	55
$Cs_4CdBi_2Cl_{12}$	Mn^{2+}	605 nm	56.6	Hydrothermal Method	56
$Cs_2AgBiCl_6$	In^{3+}	570 nm	36.6%	Anti-solvent recrystallization	63
	Na^{+}	610 nm	45%	Hydrothermal Method	59
$CsMnBr_3$	-	643 nm	54%	Hot-injection Method	53
$Cs_2InBr_5 \cdot H_2O$	Sb^{3+}	695 nm	35.6%	Hydrothermal Method	42
Cs_2SnCl_6	Sb^{3+}	615 nm	8.45%	Hot-injection Method	57
	Sb^{3+}	602 nm	37%	Hydrothermal Method	60
Cs_2SnI_6	-	620 nm	0.48%	Hot-injection Method	62

Table S3 The detailed CIE coordinate of the xSb^{3+}:$Rb_2InCl_5·H_2O$ perovskites.

xSb^{3+}:$Rb_2InCl_5·H_2O$	CIE x	CIE y
5%	0.4817	0.4468
10%	0.4971	0.4346
20%	0.5100	0.4405
30%	0.4866	0.4428
40%	0.4941	0.4434
50%	0.4869	0.4441
60%	0.4878	0.4440

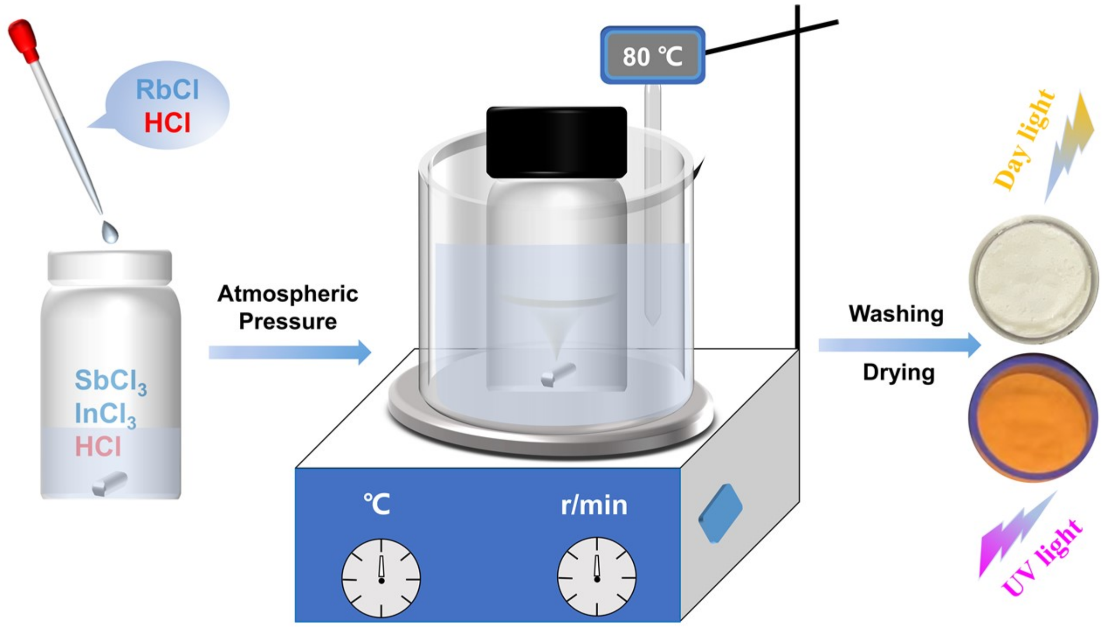

Figure S1. Schematic illustration showing the preparation procedure of Sb^{3+}:$Rb_2InCl_5·H_2O$ powders.

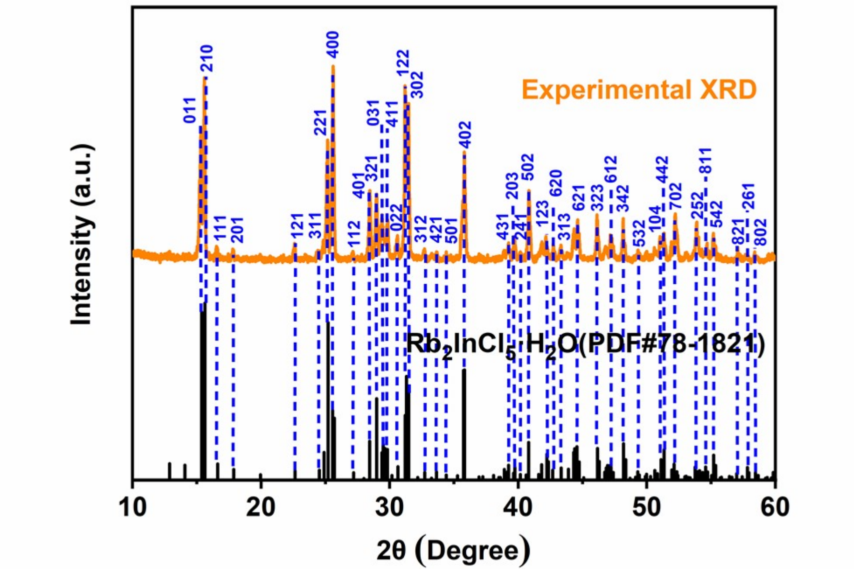

Figure S2. XRD patterns of $Rb_2InCl_5{\cdot}H_2O$ samples and PDF #78-1821 from ICSD.

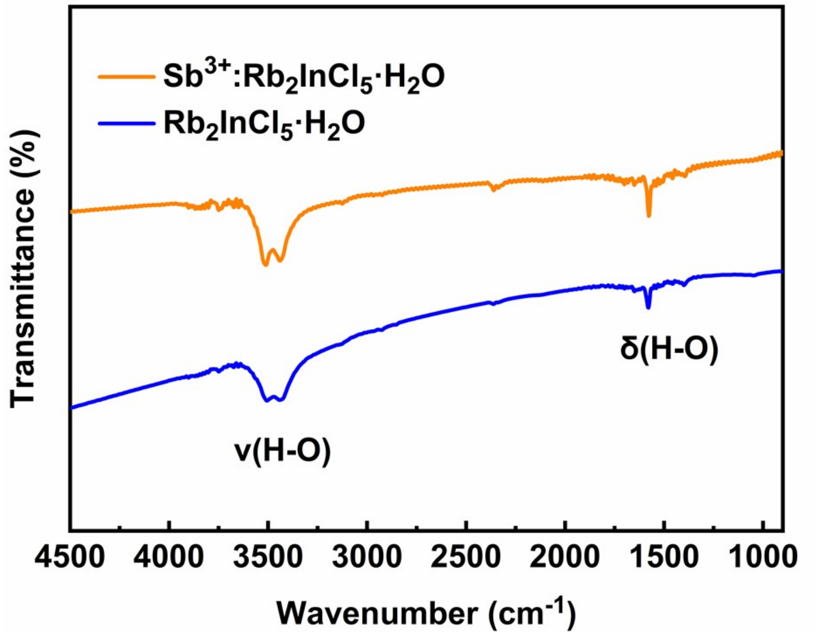

Figure S3. FTIR spectra of $Rb_2InCl_5{\cdot}H_2O$ and Sb^{3+}:$Rb_2InCl_5{\cdot}H_2O$.

The broad absorption peak from 3000 to 3600 cm^{-1} is ascribed to the H-O stretching vibration ($\nu_{H\text{-}O}$), and the narrow absorption peak in the range of 1500 - 1600 cm^{-1} is attributed to the H-O bending vibration ($\delta_{H\text{-}O}$). The result confirms that the presence of the coordinating water in $Rb_2InCl_5{\cdot}H_2O$ and $Rb_2InCl_5{\cdot}H_2O{:}Sb^{3+}$, also consistent with the previous report.[1, 2]

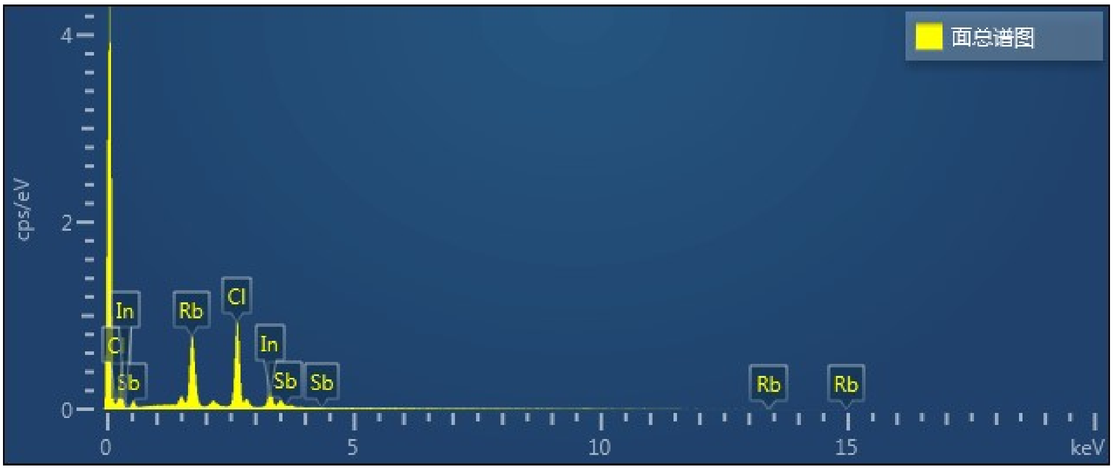

Figure S4. **EDS spectrum of 40%Sb^{3+}:$Rb_2InCl_5{\cdot}H_2O$ powders, showing the elements of Rb, In, Cl, and Sb in the powders.**

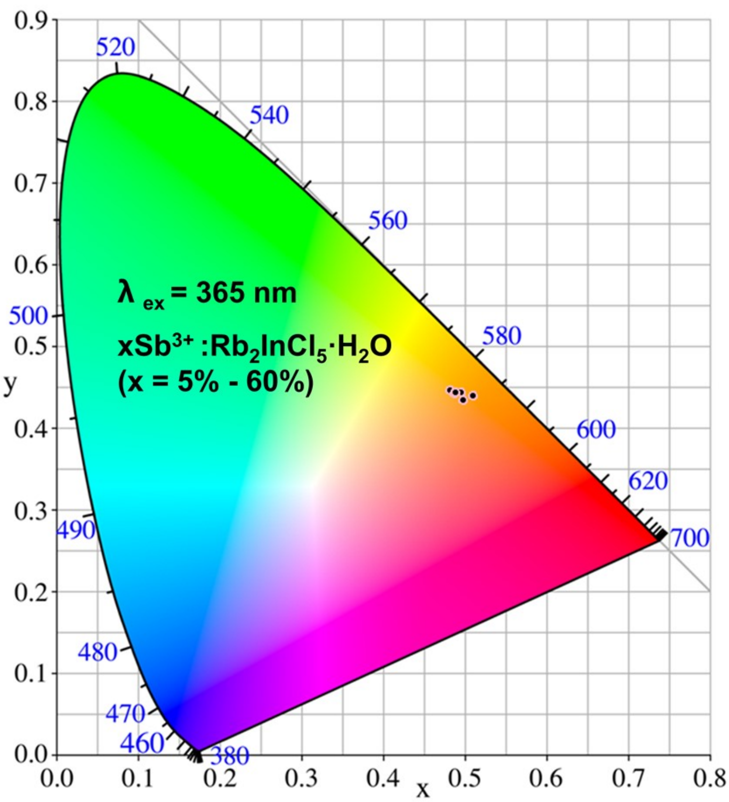

Figure S5. CIE coordinate of xSb^{3+}:$Rb_2InCl_5{\cdot}H_2O$(x = 5% - 60%).

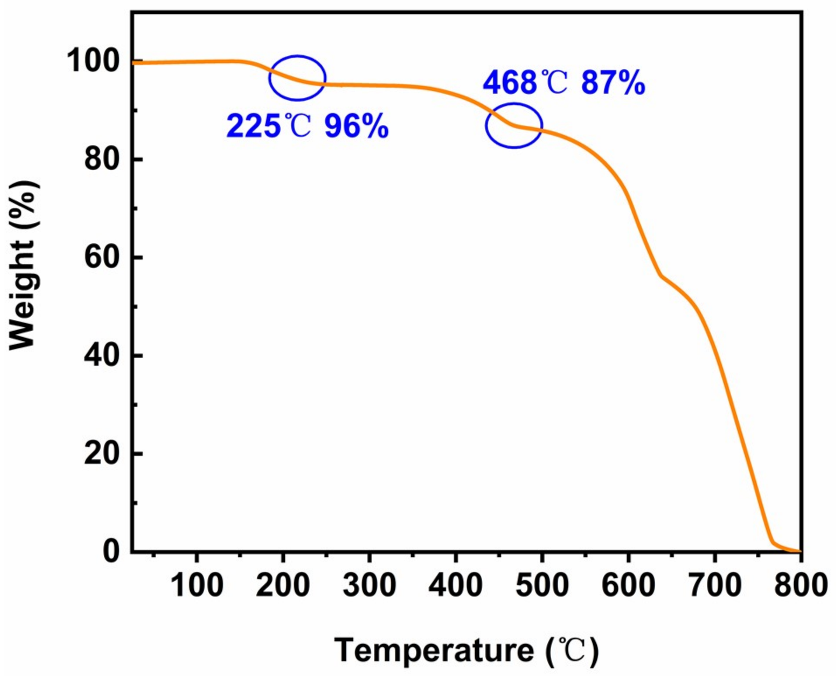

Figure S6. TGA curve of 40%Sb^{3+}:$Rb_2InCl_5{\cdot}H_2O$.

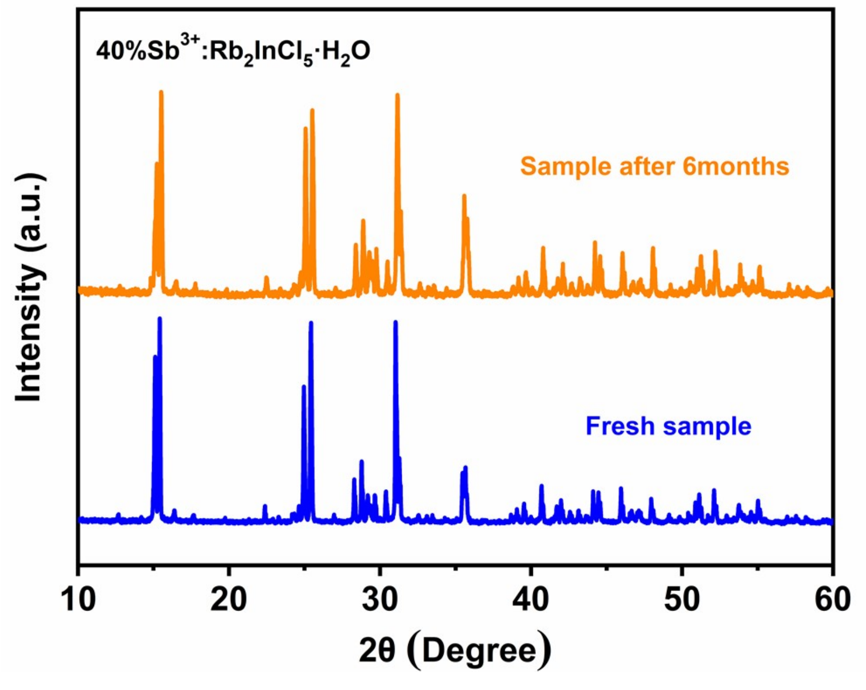

Figure S7. Comparison of the XRD patterns of 40%Sb^{3+}:$Rb_2InCl_5{\cdot}H_2O$ fresh sample and 40%Sb^{3+}:$Rb_2InCl_5{\cdot}H_2O$ as synthesized after six months.

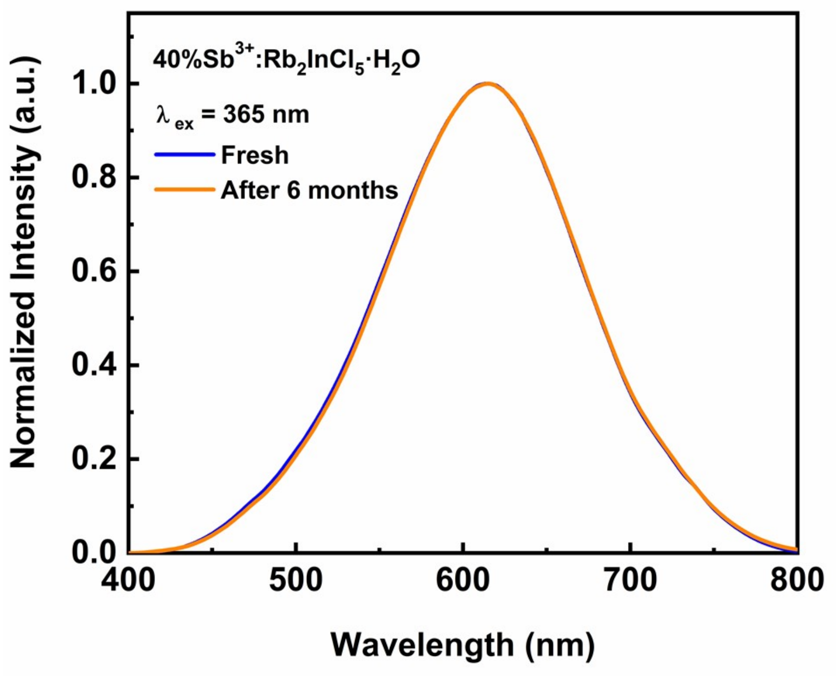

Figure S8. Normalized PL spectra of 40%Sb^{3+}:$Rb_2InCl_5·H_2O$ fresh sample and 40%Sb^{3+}:$Rb_2InCl_5·H_2O$ as synthesized after six months.

Reference

[1] L. Zhou, J.F. Liao, Z.G. Huang, J.H. Wei, X.D. Wang, W.G. Li, H.Y. Chen, D.B. Kuang, C.Y. Su, A Highly Red-Emissive Lead-Free Indium-Based Perovskite Single Crystal for Sensitive Water Detection, *Angew. Chem. Inter.* Ed. **2019**, 58, 5277-5281.

[2] J.-H. Wei, J.-B. Luo, J.-F. Liao, W.-T. Ou, D.-B. Kuang, Te^{4+}-doped $Cs_2InCl_5·H_2O$ single crystals for remote optical thermometry, Sci. *China Mater.* **2021**, 65, 764-772.