Supporting Information

Lead-Free Rb_2SnCl_6:Bi Perovskite Nanocrystals for Luminescence Emission

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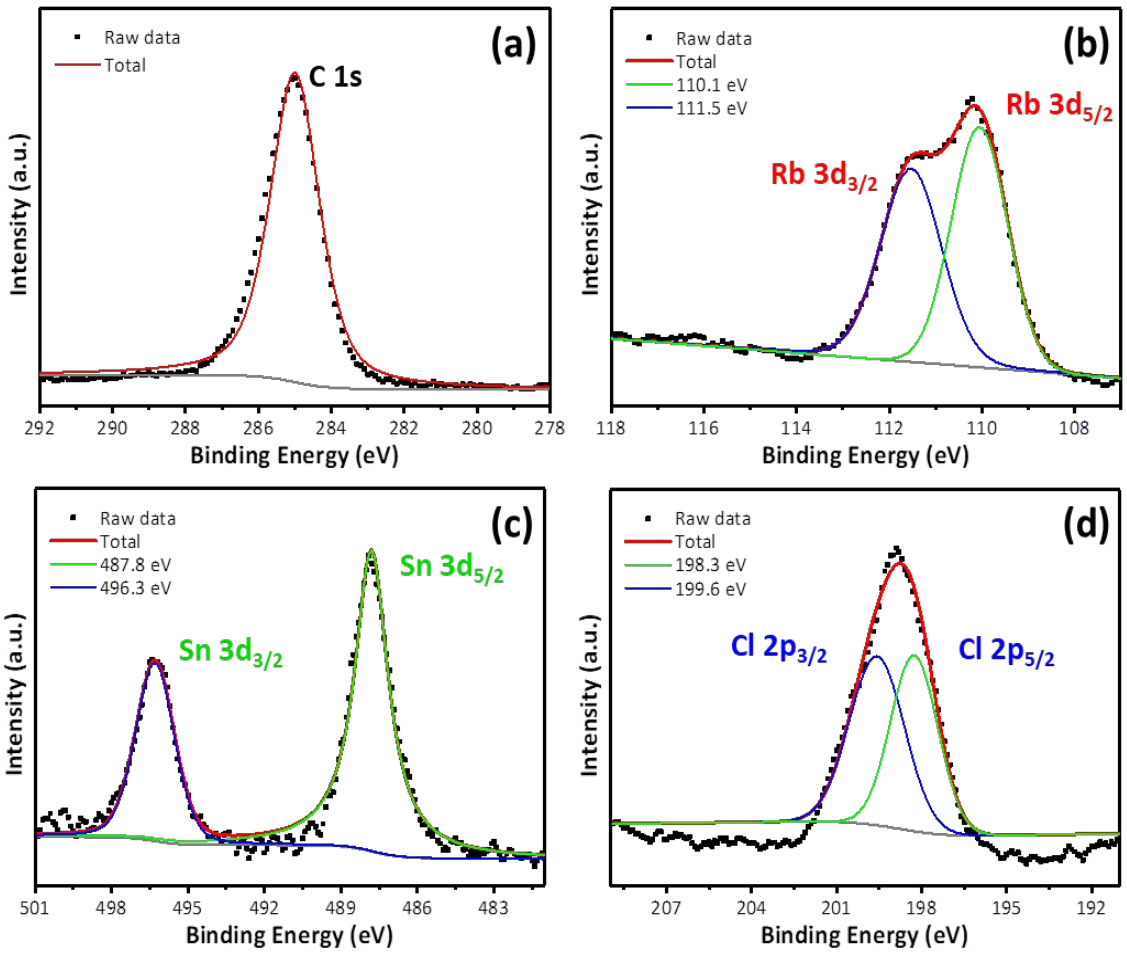

Figure S1. High-resolution XPS spectra of pure Rb_2SnCl_6 for (a) C 1*s*; (b) Rb 3*d*; (c) Sn 3*d*; and (d) Cl 2*p* high-energy discrimination spectra.

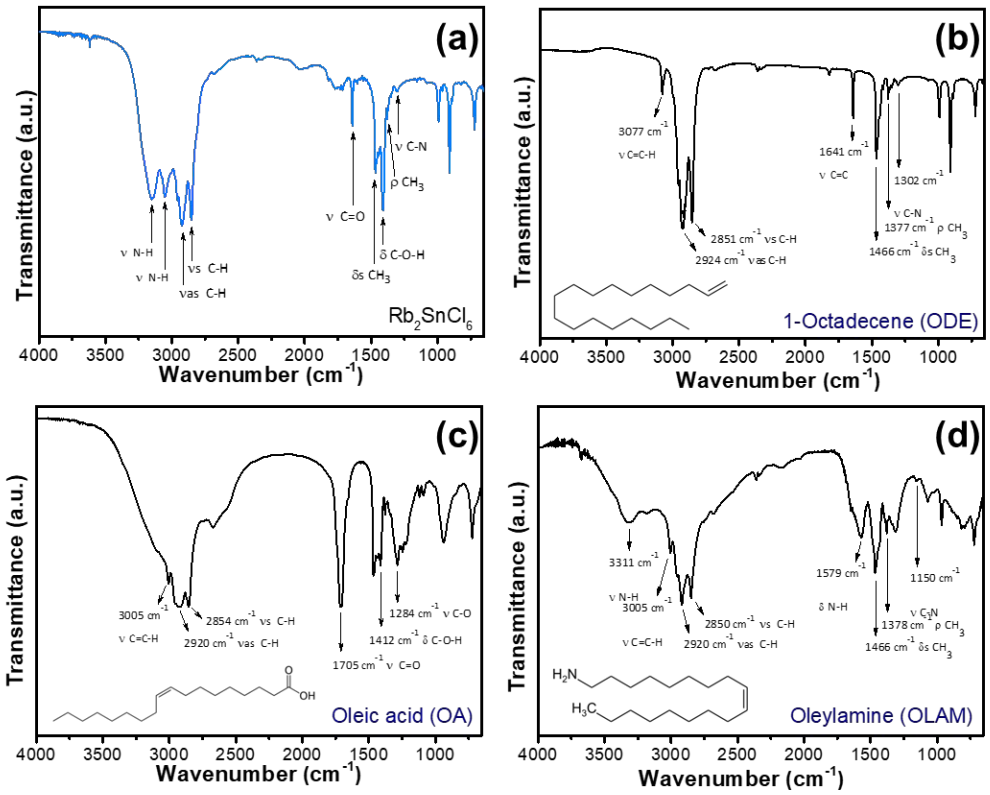

Figure S2. FT-IR spectra of (a) Rb_2SnCl_6 perovskites; (b, c, and d) reference spectra of 1-octadecane (ODE), oleic acid (OA), and oleylamine (OLAM) for comparison.

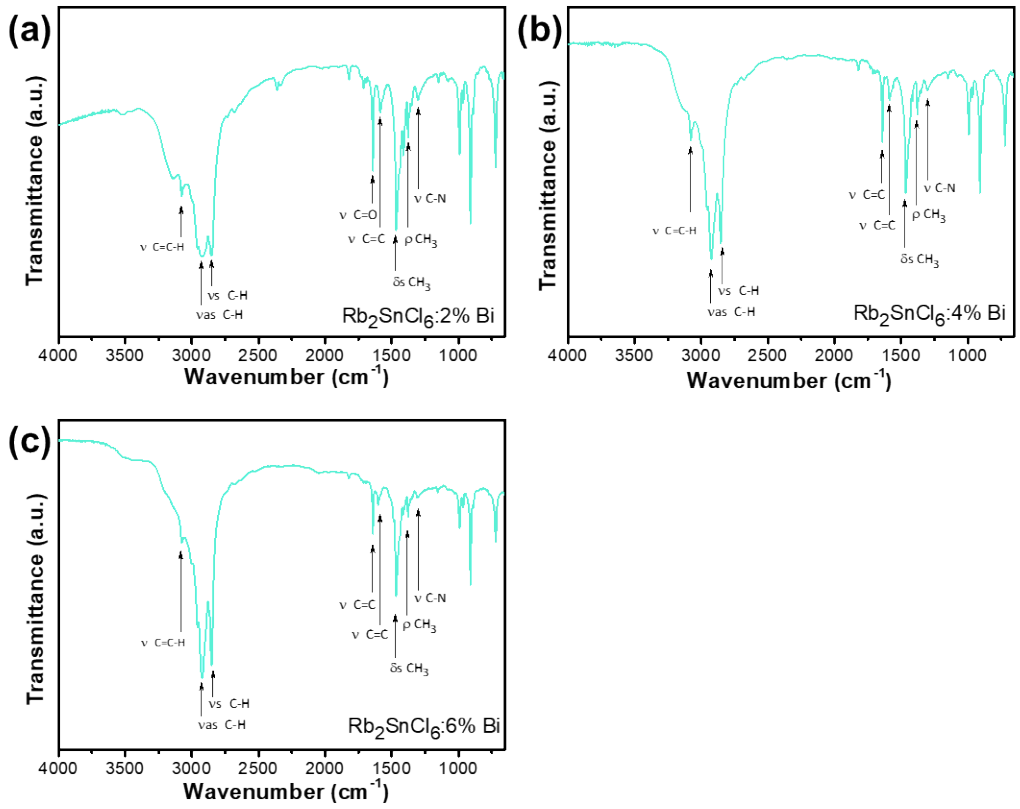

Figure S3. FT-IR spectra of newly developed perovskite nanocrystals Rb_2SnCl_6:X%Bi of (a) X = 2; (b) X = 4; and (c) X = 6.

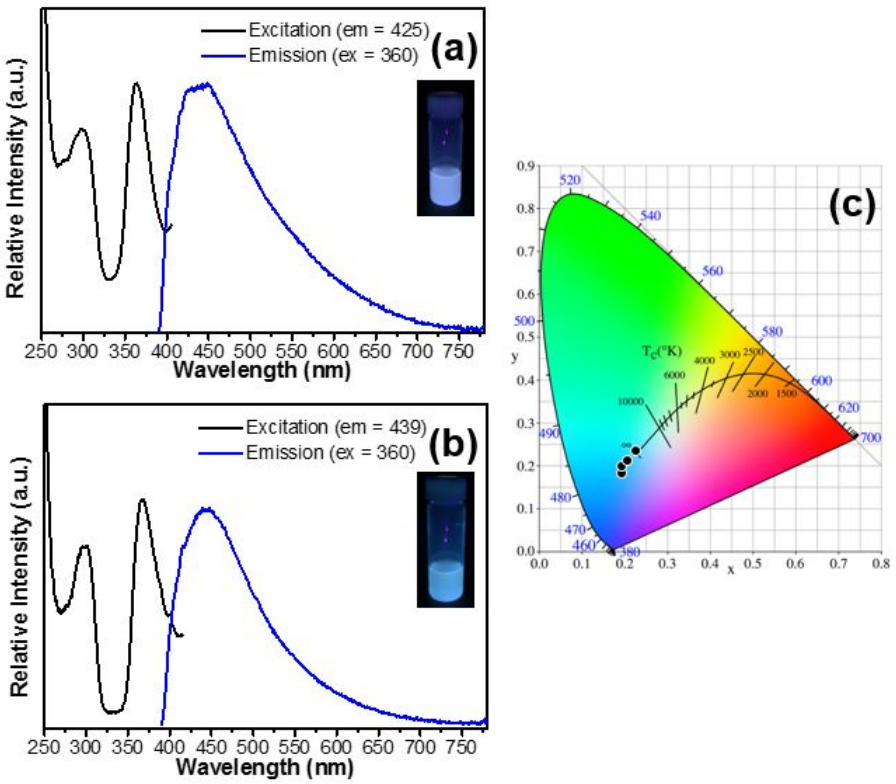

Figure S4. Excitation and emission spectra of (a) Rb_2SnCl_6:2%Bi; (b) Rb_2SnCl_6:6%Bi, & (c) location of Rb_2SnCl_6:X%Bi in CIE 1931 chromaticity diagram.

Table S1. Structural parameters of Rb_2SnCl_6 nanocrystals determined by Rietveld refinement of the corresponding XRD pattern.

Cell Parameters			
Space group: *Fm-3m* (225)		Reliability values	
a (Å)	10.1218 (3)	R_{wp} (%)	8.64
V (Å^3)	1037.00 (2)	R_p (%)	5.61
Z	4	R_{exp} (%)	4.09
Rb-Cl	3.580 (1)	χ^2	2.11
Sn-Cl	2.443 (2)	R (F^2) (%)	7.05

Fractional atomic coordinates						
Atoms	**x**	**y**	**z**	**Occ**	U_{iso}	**Site**
Rb	0.25000	0.25000	0.25000	1.000	0.088	8
Sn	0.00000	0.00000	0.00000	1.000	0.070	4
Cl	0.24133	0.00000	0.00000	1.000	0.081	24

Table S2. Binding energy of Rb, Sn, Cl, and Bi among Rb_2SnCl_6 and Rb_2SnCl_6:4%Bi nanocrystals.

Cpd.	**Binding Energy (eV)**							
	Rb		Sn		Cl		Bi	
	$3d_{5/2}$	$3d_{3/2}$	$3d_{5/2}$	$3d_{3/2}$	$2p_{5/2}$	$2p_{3/2}$	$4f_{7/2}$	$4f_{5/2}$
Rb_2SnCl_6	110.1	111.5	487.8	496.3	198.3	199.6	-	-
Rb_2SnCl_6:4%Bi	109.7	111.1	487.1	495.6	198.4	199.8	159.6	164.8

Table S3. Position of Rb_2SnCl_6:X%Bi (X = 0, 2, 4, and 6) in CIE 1931 chromaticity diagram.

Nanocrystals	**X-axis on CIE diagram**	**Y-axis on CIE diagram**
Rb_2SnCl_6	0.1924	0.1911
Rb_2SnCl_6:2%Bi	0.1934	0.1941
Rb_2SnCl_6:4%Bi	0.2235	0.2360
Rb_2SnCl_6:6%Bi	0.2038	0.2101

Table S4. Fluorescence decay analysis of Rb_2SnCl_6 perovskites nanocrystals.

Parameter	Value	Conf. $_{Lower}$	Conf. $_{Upper}$
A_1 (Cnts)	3950.51	-74.1987	+74.1987
τ_1 (ns)	0.73334	-0.01166	+0.01166
A_2 (Cnts)	4454.36	-47.9737	+47.9737
τ_2 (ns)	2.73395	-0.06077	+0.06077
A_3 (Cnts)	1537.33	-60.7045	+60.7045
τ_3 (ns)	9.02262	-0.21564	+0.21564

Table S5. Fluorescence decay analysis of Rb_2SnCl_6:4%Bi perovskites nanocrystals.

Parameter	Value	Conf. $_{Lower}$	Conf. $_{Upper}$
A_1 (Cnts)	5745.19	-32.4380	+32.4380
τ_1 (ns)	0.93414	-0.01059	+0.01059
A_2 (Cnts)	446.412	-32.6435	+32.6435
τ_2 (ns)	10.6624	-1.61286	+1.61286