In situ growth of Te-doped Cs_2SnCl_6 scintillator composite films for X-ray imaging

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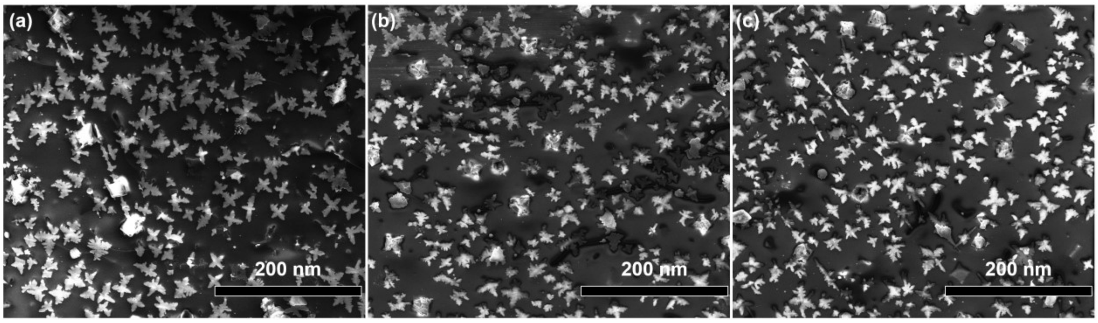

Figure S1. SEM images of a) Cs_2SnCl_6:Te 5%/PMMA CF, b) Cs_2SnCl_6:Te 10%/PMMA CF and c) Cs_2SnCl_6:Te 20%/PMMA CF.

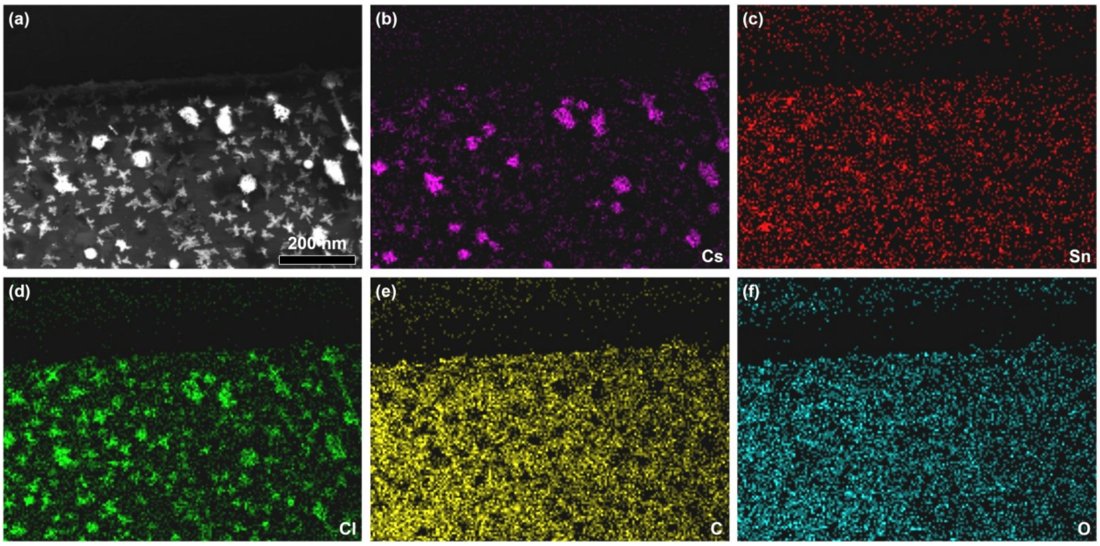

Figure S2. EDS mapping of Cs_2SnCl_6/PMMA CF.

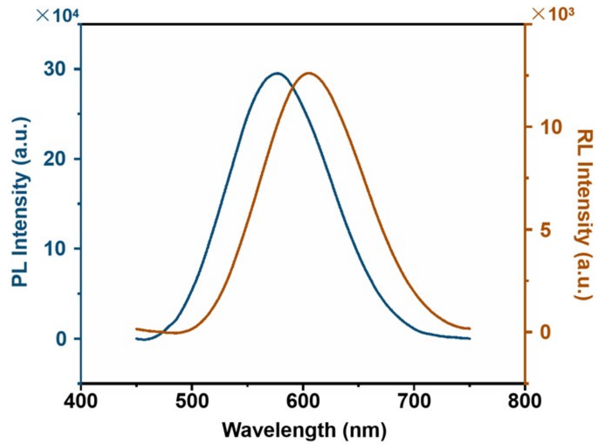

Figure S3. RL spectra at a dose rate of 200 $nGy_{air}s^{-1}$ and PL spectra of Cs_2SnCl_6:Te 15%/PMMA CFs.

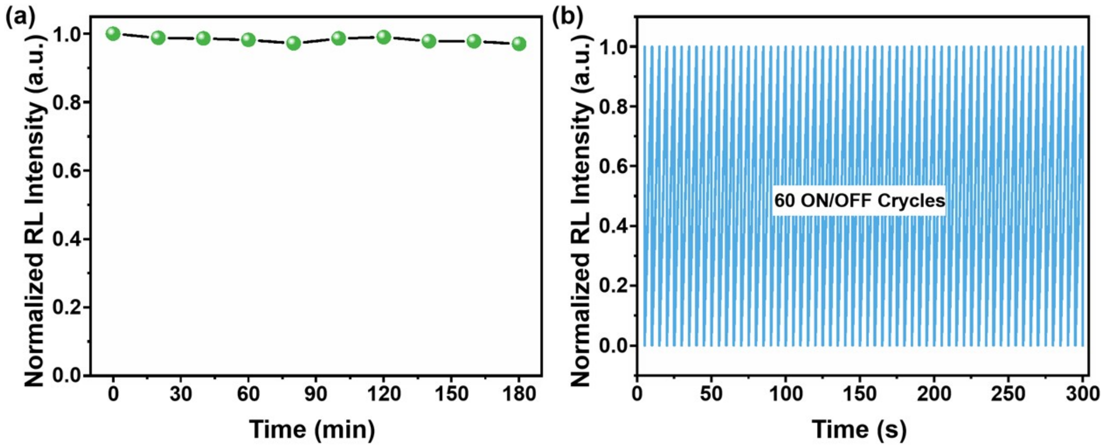

Figure S4. (a) Normalized RL spectra of Cs_2SnCl_6:Te 15%/PMMA CFs under continuous X-ray irradiation. (b) RL intensities recorded for Cs_2SnCl_6:Te 15%/PMMA CFs over continuous 60 on/off cycles. (dose rate: 10 $\mu Gyair_s^{-1}$, tube voltage: 50 kV)

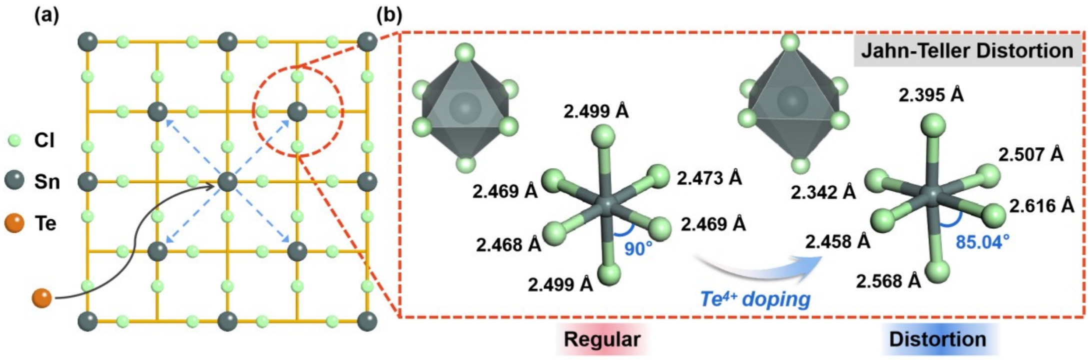

Figure S5. a) Cs_2SnCl_6: Te^{4+} cell structure, in which Te^{4+} ion replaces Sn^{4+} ion. b) Jahn–Teller distortion: schematic diagrams of $[SnCl_6]^{2-}$ octahedra without doping (regular) and with doping (distortion).

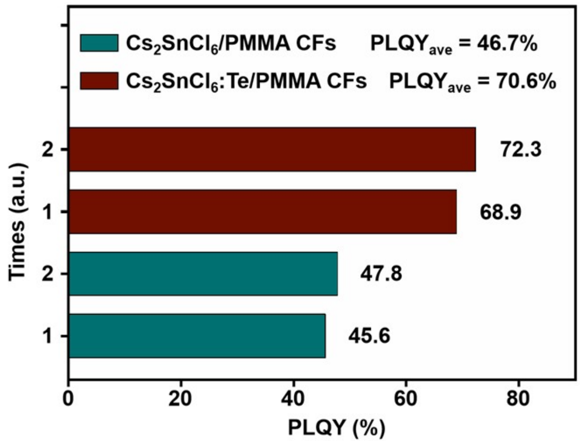

Figure S6. The PLQY value of Cs_2SnCl_6/PMMA CFs and Cs_2SnCl_6:Te 15%/PMMA CFs

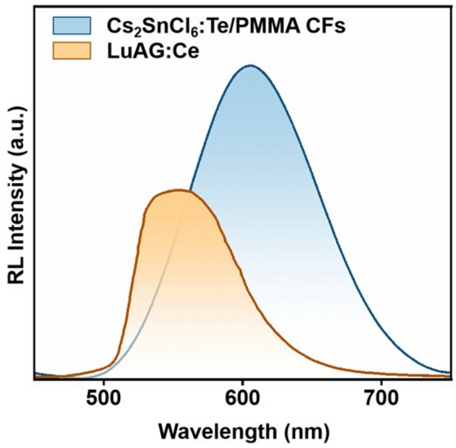

Figure S7. RL spectra of Cs_2SnCl_6:Te/PMMA CFs and LuAG:Ce(dose rate: 10 μGyair$_s^{-1}$, tube voltage: 50 kV)

Table S1 Bi-exponential fitting results of PL decays for Cs_2SnCl_6:Te/PMMA CFs with different Te content.

Sample	τ_1 (ns)	A_1 (%)	τ_2 (ns)	A_2 (%)	τ_{ave} (ns)
Cs_2SnCl_6:Te/PMMA-5%	83.5	76.5	1353.2	23.5	1140.2
Cs_2SnCl_6:Te/PMMA-10%	96.1	73	1597.5	27	1387.1
Cs_2SnCl_6:Te/PMMA-15%	129	49.9	1756.9	50.1	1620.4
Cs_2SnCl_6:Te/PMMA-20%	112	55.5	1562	44.5	1464.7

The decay trajectories of all samples can be fitted to the double exponential function Y(t) according to the following nonlinear least squares:

$$Y(t) = A_1 e^{-\frac{t}{\tau_1}} + A_1 e^{-\frac{t}{\tau_2}} \cdots\cdots(S1)$$

where A_1, A_2 are the contributions to the time-resolved emission decay lifetimes τ_1, τ_2, respectively.

The average lifetime of the sample (τ_{ave}) can be obtained from the following equation:

$$\tau_{ave} = \frac{A_1{\tau_1}^2 + A_2{\tau_2}^2}{A_1\tau_1 + A_2\tau_2} \cdots\cdots(S2)$$

Table S2 Nominal and actual Te/(Sn+Te) co-doping concentrations in Cs_2SnCl_6: Te micro−crystals. The nominal Te doping ratio was defined as the molar ratio of Te/(Sn+Te) in the precursor solution, and the actual Te/(Sn+Te) ratio was determined by ICP-MS

Sample	**Te^{4+} (g)**	**Te^{4+} (mol)**	**Sn^{4+} (g)**	**Sn^{4+} (mol)**	**Te/Sn doping ratio (mol/mol)**
Cs_2SnCl_6	0	0	0.000046	3.87564E-7	0% / 100%
Cs_2SnCl_6:Te-5%	0.000003	2.3511E-8	0.000051	4.29691E-7	5.19% / 94.81%
Cs_2SnCl_6:Te-10%	0.000006	4.70219E-8	0.000042	3.53863E-7	11.73% / 88.27%
Cs_2SnCl_6:Te-15%	0.000007	5.48589E-8	0.000037	3.11736E-7	14.96% / 85.04%
Cs_2SnCl_6:Te-20%	0.00001	7.83699E-8	0.000035	2.94886E-7	20.99% / 79.01%

Table S3 Summary of X-ray scintillation performances of lead-free metal halides scintillation screens.

Sample	**Attributes**	**Light yield (photons MeV^{-1})**	**Detection limit ($nGy_{air}s^{-1}$)**	**Radiation stability**	**Ref.**
$(R/S\text{-}PPA)_2BiI_5$	Rigid	-	270	120 min 2.29 $mGy_{air}s^{-1}$	[1]
Cs_3MnBr_5 NC-embedded glass	Rigid	5200	787	60 min 5.775 $mGy_{air}s^{-1}$	[2]
$Cs_4Cd_{0.75}Mn_{0.25}Bi_2Cl_{12}$	Flexible	34450	183.6	180 min 10.53 $mGy_{air}s^{-1}$	[3]
Cs_3TbCl_6	Flexible	56800	149.65	240 min -	[4]
$Cs_3Cu_2I_5$	Flexible	32,000	150.55	120 min 6.8 $mGy_{air}s^{-}$	[5]
Cs_2SnCl_6:Te/PMMA	Flexible	36000	112	180 min 10 $\mu Gy_{air}s^{-1}$	This work

Reference

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