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

Supporting information

Dopant-compensated $Cs_2AgBiBr_{6-x}Cl_x$ single crystals for photo-imaging and X-ray detection

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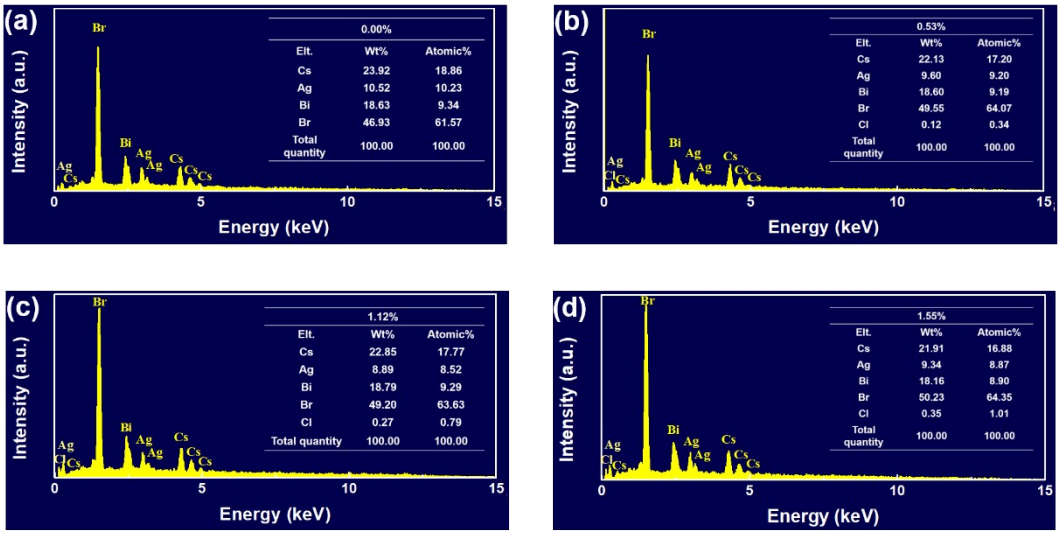

Fig. S1 The EDS spectrum for the $Cs_2AgBiBr_{6-x}Cl_x$ SCs with different Cl^- doping ratios. (a) 0.00%, (b) 0.53%, (c) 1.12%, and (d) 1.55%..

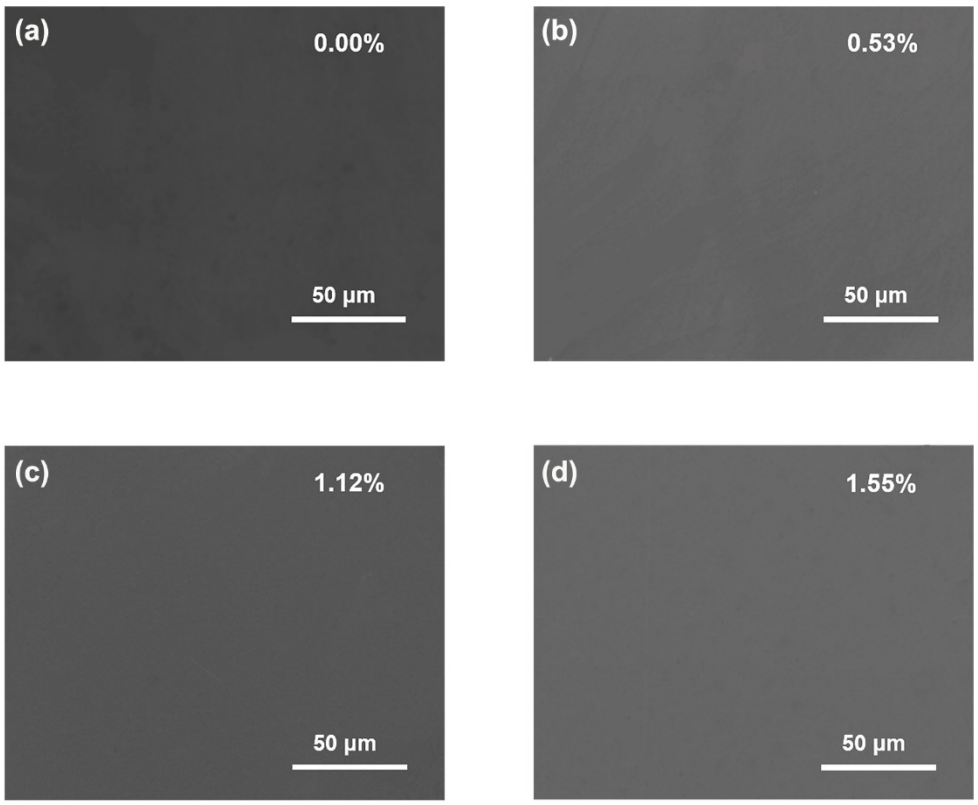

Fig. S2 The SEM images of the $Cs_2AgBiBr_{6-x}Cl_x$ SCs with different Cl^- doping ratios. (a) 0.00%, (b) 0.53% (c) 1.12% and (d) 1.55%.

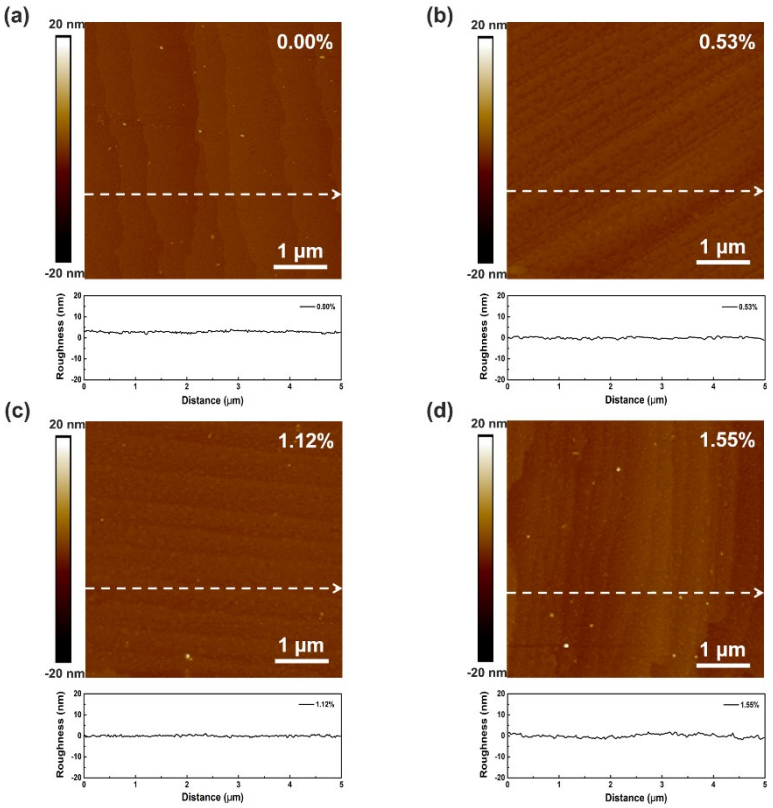

Fig. S3. The AFM images of the $Cs_2AgBiBr_{6-x}Cl_x$ SCs with different Cl^- doping ratios. (a) 0.00%, (b) 0.53% (c) 1.12% and (d) 1.55%.

Table S1. Ionic radius in $Cs_2AgBiBr_{6-x}Cl_x$.

Ions	Cs^+	Ag^+	Bi^{3+}	Br^-	Cl^-
Radius (Å)	1.67	1.15	1.03	1.96	1.81

Table S2. The octahedral factors and tolerance factors of $Cs_2AgBiBr_{6-x}Cl_x$.

Cl amount	0.00%	0.53%	1.12%	1.55%
octahedral factor	0.55612	0.55635	0.55661	0.55680
tolerance factor	0.84157	0.84160	0.84164	0.84168

Hall effect measurement was conducted on SCs with the size of 3 × 3 × 2 mm^3 in dark using Nanometrics HL5500 Hall System.

Table S3. The measured resistivity, majority carrier concentration and mobility of $Cs_2AgBiBr_{6-x}Cl_x$

Cl amount	Resistivity (Ω cm)	Carrier concentration (cm^{-3})	Mobility ($cm^2V^{-1}s^{-1}$)
0.00%	9.484×10^6	2.407×10^{10}	27.3
0.53%	2.39×10^9	3.722×10^7	70.3
1.12%	1.068×10^{10}	4.512×10^6	129.0
1.55%	1.817×10^{11}	2.076×10^6	16.5

SC detectors with different Cl^- doping ratios.

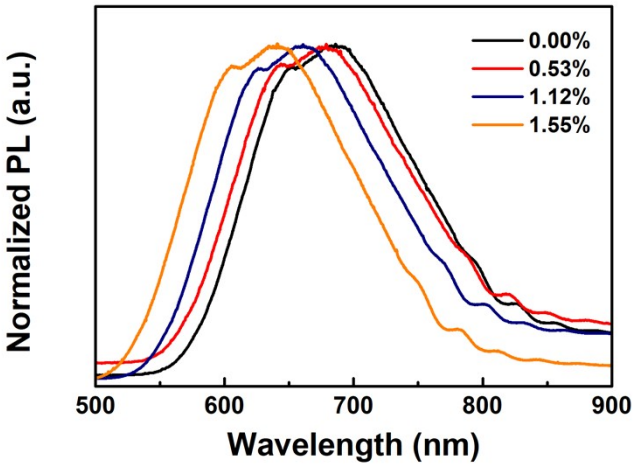

Fig. S4. PL spectra of the $Cs_2AgBiBr_{6-x}Cl_x$ SCs with different Cl^- ratios.

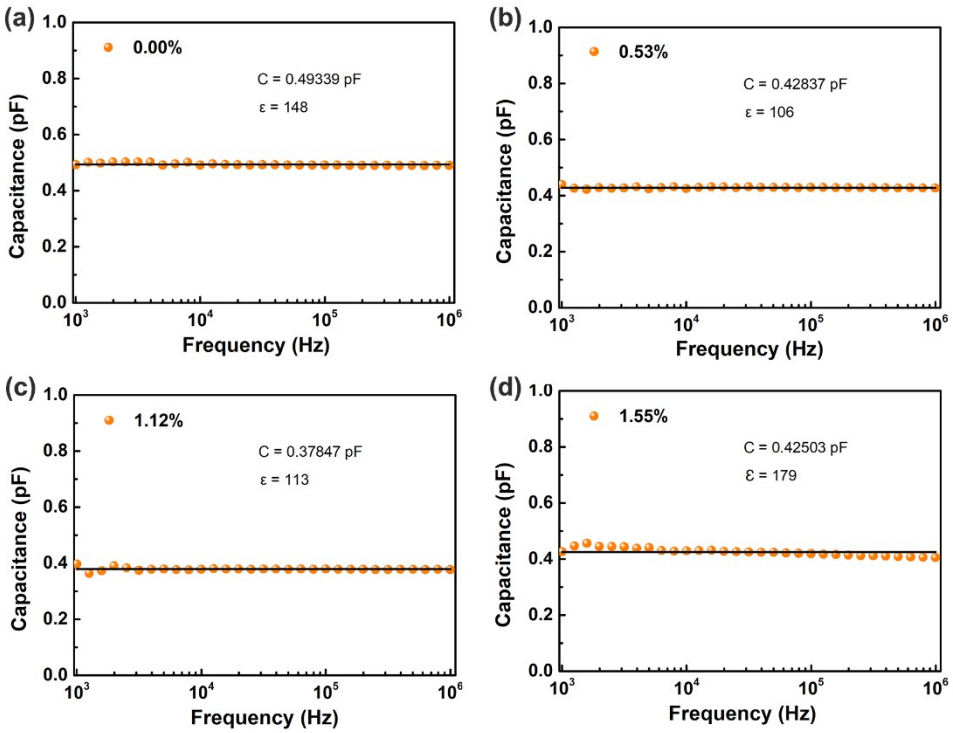

Fig. S5 Capacitance of Au/$Cs_2AgBiBr_{6-x}Cl_x$/Au parallel plate capacitor.

Note S1. The calculation of $Cs_2AgBiBr_{6-x}Cl_x$ SCs relative dielectric constant

A simple plate capacitor was built to measure the relative dielectric constant of $Cs_2AgBiBr_{6-x}Cl_x$ SC. Device configuration was Au/$Cs_2AgBiBr_{6-x}Cl_x$/Au, and the $Cs_2AgBiBr_{6-x}Cl_x$ SC was served as the dielectric layer. By measuring the capacitance-frequency at dark, as shown in Figure S3. The relative dielectric constant was obtained by using the parallel plate capacitor model:

$$C = \varepsilon\varepsilon_0 S/D$$

where S is the electrode area (0.75 mm^2), D is the thickness of $Cs_2AgBiBr_{6-x}Cl_x$ SC (0.00%: 2.00 mm; 0.53%: 1.65 mm; 1.12%: 1.98 mm; 1.55%: 2.5 mm).

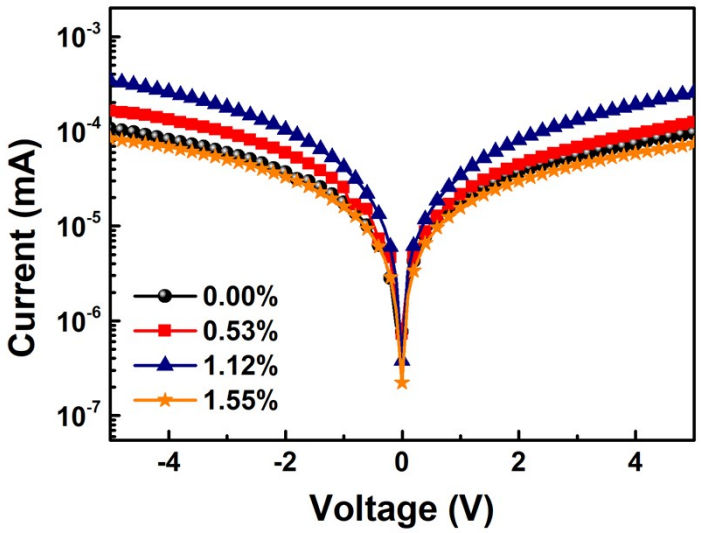

Fig. S6 The *I-V* curves of the SC devices with Cl^- doping ratio of 0.00%, 0.53%, 1.12% and 1.55% at 2 mW cm^{-2} conditions.

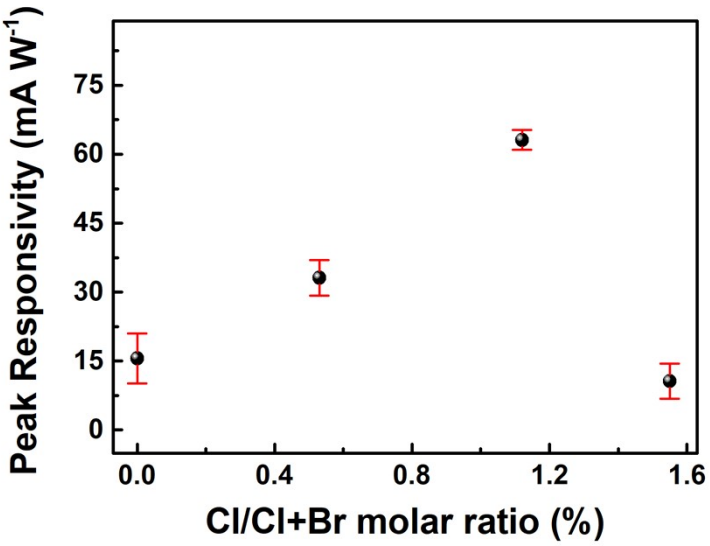

Fig. S7 Peak response of the $Cs_2AgBiBr_{6-x}Cl_x$ SC detectors with different Cl^- ratios at 5 V.

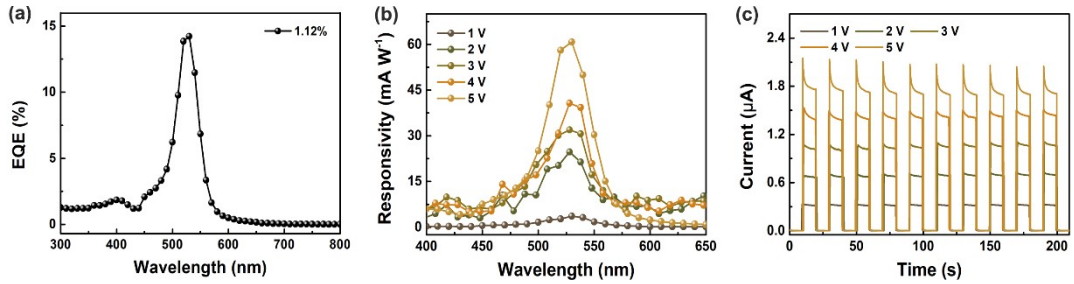

Fig. S8 (a) The EQE spectrum for the $Cs_2AgBiBr_{5.933}Cl_{0.067}$ photodetector at 5 V. (b) The photoresponse curves of $Cs_2AgBiBr_{5.933}Cl_{0.067}$ SC at different bias. (c) Time-dependent response of the $Cs_2AgBiBr_{5.933}Cl_{0.067}$ SC devices under different bias.

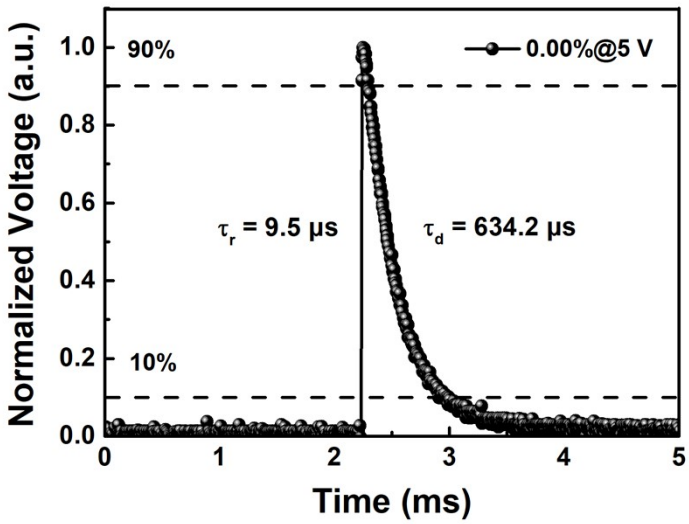

Fig. S9 The Time-resolved response for the $Cs_2AgBiBr_6$ SC photodetector at 5 V under the excitation of 532 nm pulsed laser.

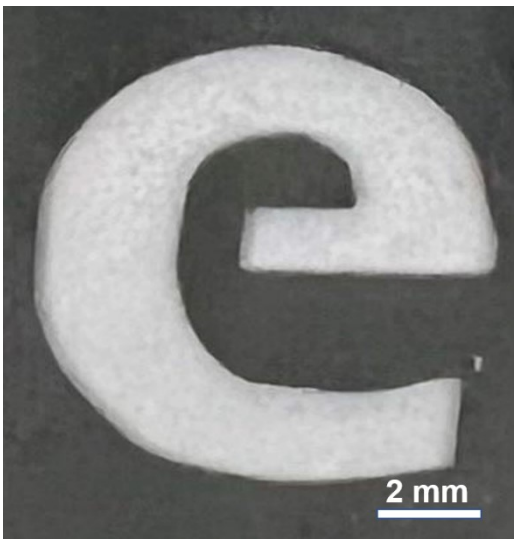

Fig. S10 The object of the imaging system with letter “e”.

Table S4. The sensitivity of $Cs_2AgBiBr_{6-x}Cl_x$ SC detectors with different Cl ratios.

Cl ratios	0.00%	0.53%	1.12%	1.55%
Sensitivity ($\mu C\ Gy_{air}^{-1}\ cm^{-2}$)	512	542	714	243