

Cs and Br Element Doped Formamidinium Lead Halide Perovskites with Good Stability as Well as Better Optoelectronic Properties

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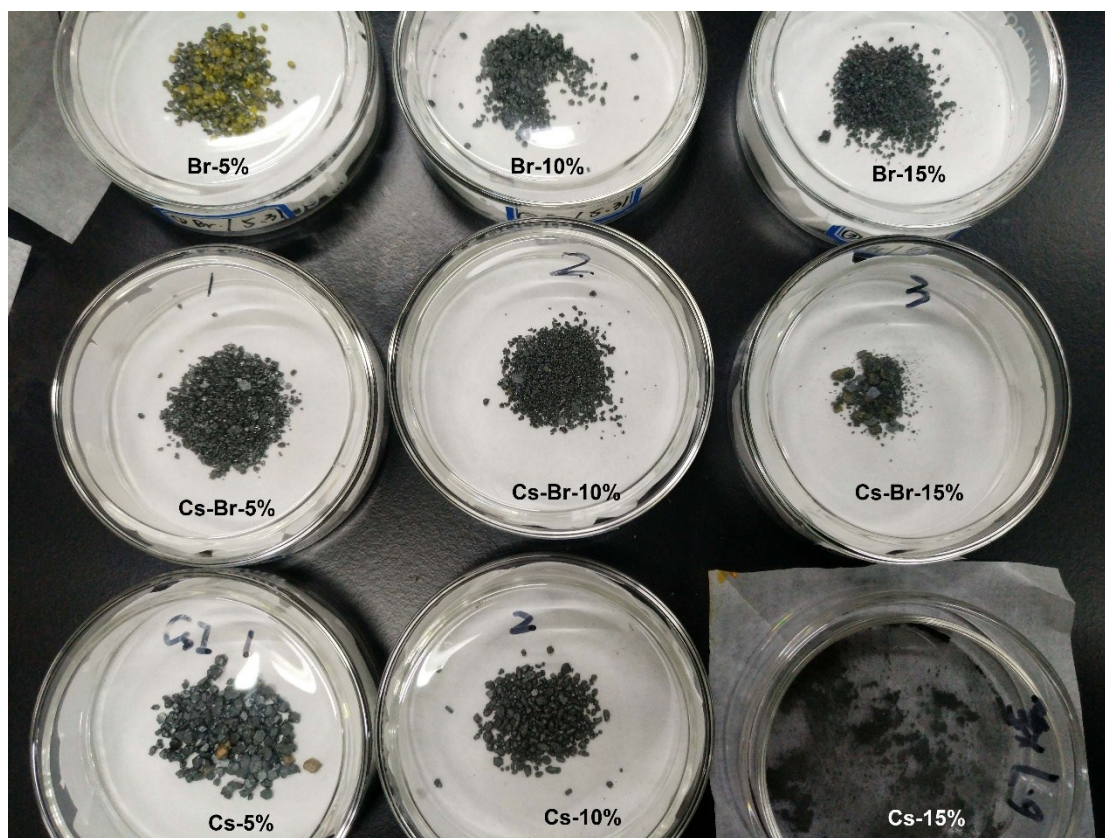


Figure S1. The photo picture of the seed crystals of doped formamidinium lead halide.

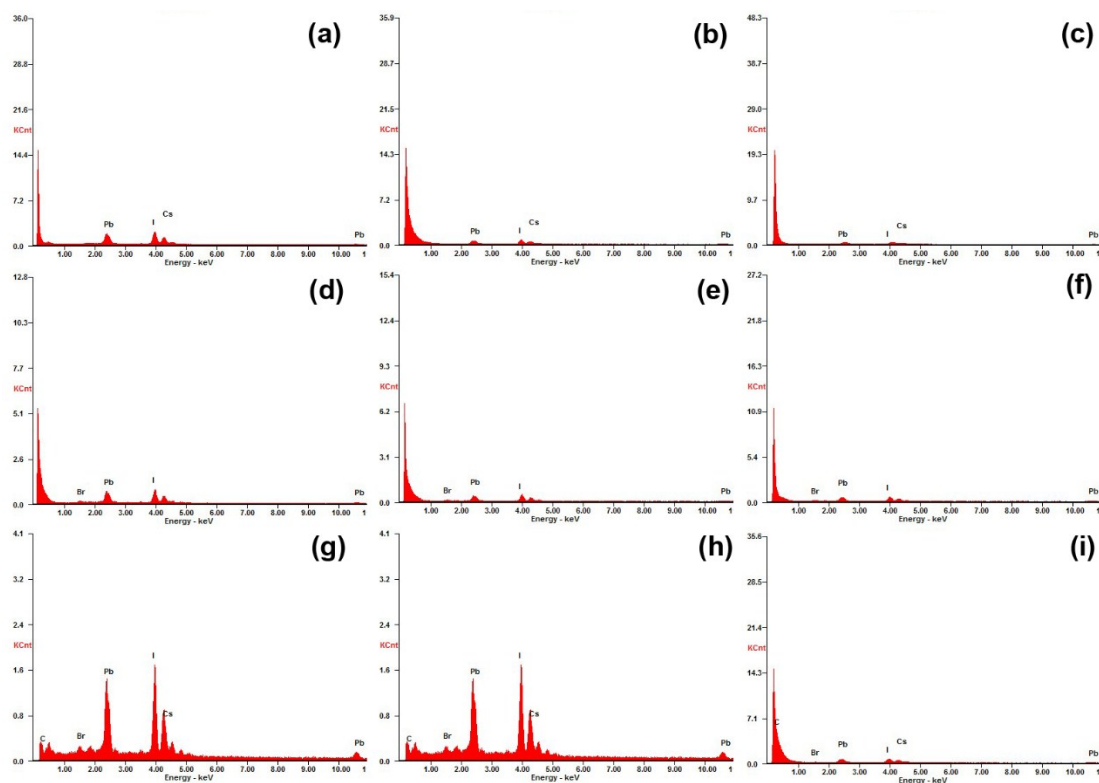


Figure S2. The EDX spectra of doped samples: Cs doping concentrations of 5% (a), 10% (b) and 15% (c); Br doping concentrations of 5% (d), 10% (e) and 15% (f); Cs-Br co-doping concentrations of 5% (g), 10% (h) and 15% (i).

Table S1. The element ratios of Cs and Br in the doped crystals.

Sample name	Atom ratio (%)				Ratio (%)	
	Cs	Pb	Br	I	Br/I	Cs/Pb
Cs-5%	5.19	26.05		69.76		0.2072
Cs-10%	10.89	22.34		66.77		0.4875
Cs-15%	38.49	15.46		46.05		2.4897
Br-5%		26.51	6.79	66.7	0.1018	
Br-10%		26.54	8.79	64.67	0.1359	
Br-15%		23.65	11.17	65.18	0.1714	
Cs-Br-5%	0.72	9.36	1.65	25.4	0.0650	0.0769
Cs-Br-10%	1.3	4.1	1.29	11.7	0.1103	0.3170
Cs-Br-15%	0.35	0.45	0.06	1.31	0.0458	0.7778

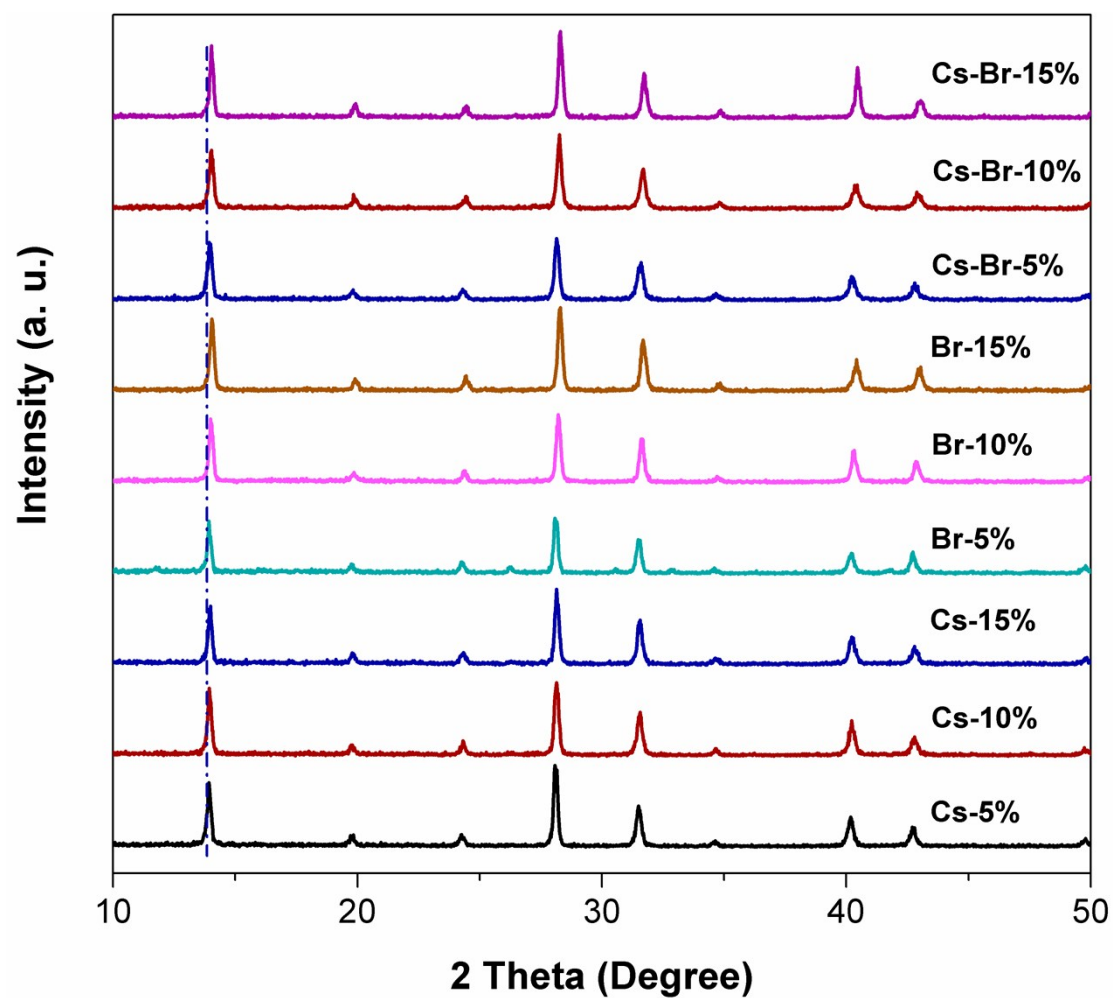


Figure S3. The XRD patterns of the obtained doped crystals, which have been measured as they were prepared.

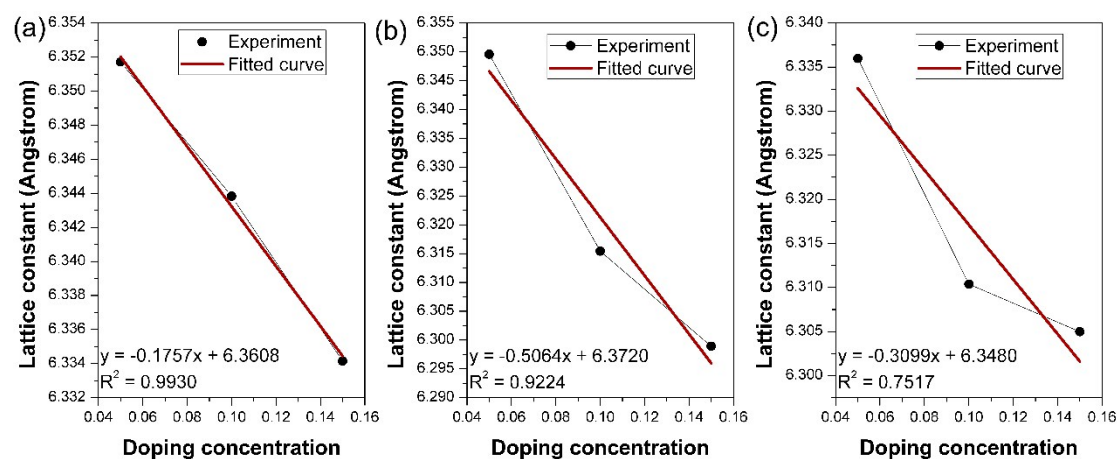


Figure S4. The lattice constants of doped crystals as a function of doping concentrations, which has been linearly fitted. Cs doped samples (a), Br doped samples (b) and Cs-Br co-doped samples (c).

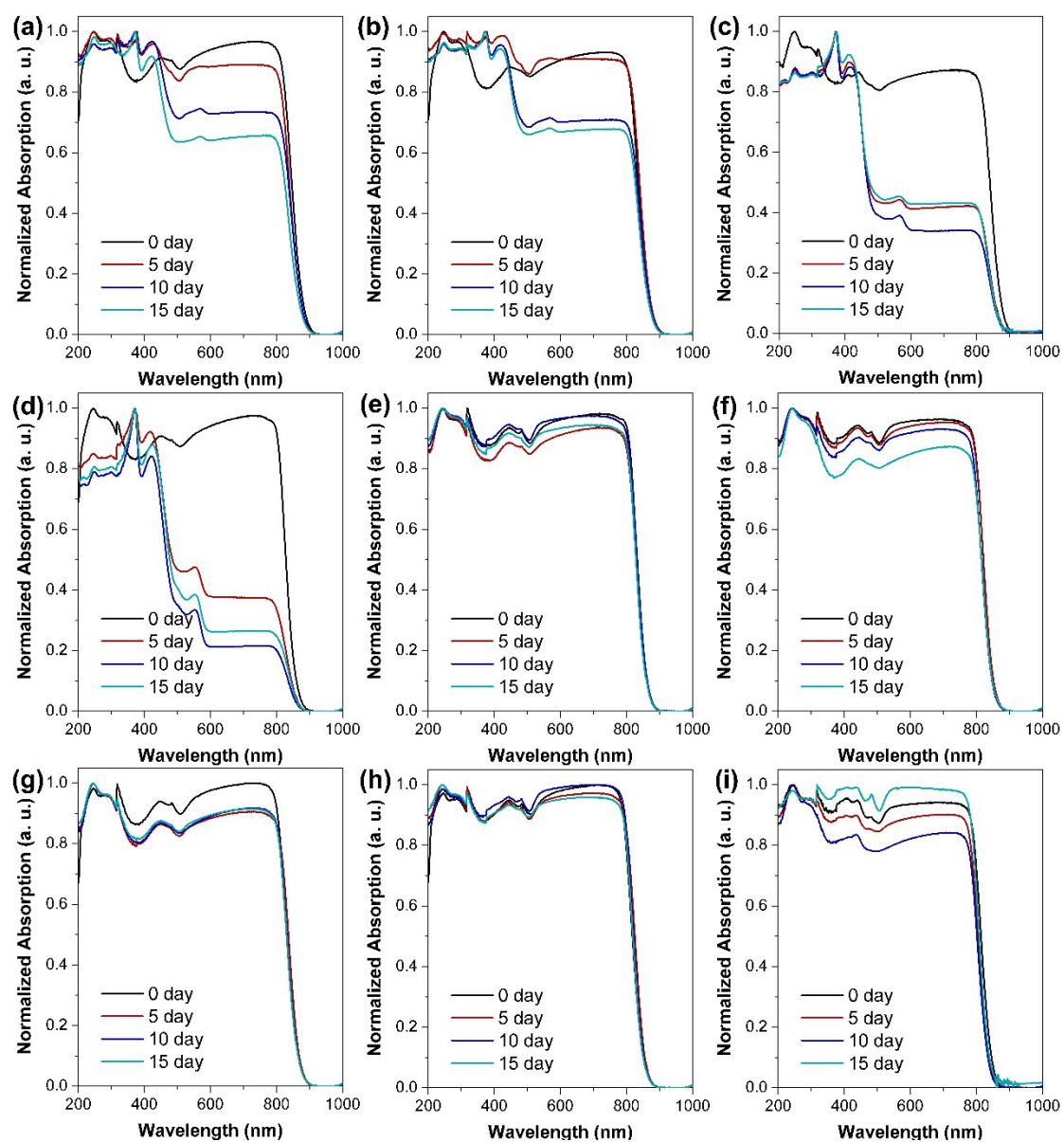


Figure S5. The light absorption properties of doped samples as a function of storing time: Cs doping concentrations of 5% (a), 10% (b) and 15% (c); Br doping concentrations of 5% (d), 10% (e) and 15% (f); Cs-Br co-doping concentrations of 5% (g), 10% (h) and 15% (i).

Table S2. The fitted parameters of TRPL curves.

Sample	A_1 (counts)	τ_1 (μ s)	A_2 (counts)	τ_2 (μ s)	A_3 (counts)	τ_3 (μ s)	τ_{average} (μ s)
Br-10%	3777	0.698	1580	0.033			0.685
Br-15%	5254	0.572	1882	0.023			0.564
Cs-Br-5%	2625	0.013	619	0.165	269	1.239	0.915
Cs-Br-10%	3999	0.027	1968	0.258	1560	1.673	1.393
Cs-Br-15%	5432	0.024	1696	0.175	470	1.258	0.786

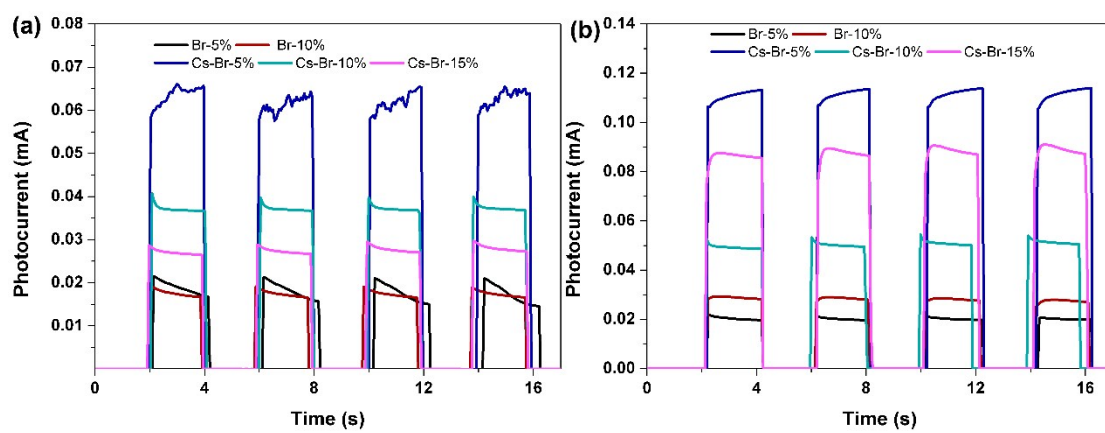


Figure S6. The current response of photodetectors based on doped formamidinium perovskite crystals under 425 nm (140 mW/cm^2) and 525 nm (150 mW/cm^2) illuminations.