Supporting information

The effect of n-Butanol on regulating the solubility-temperature characteristics for the Growth of High-Quality $CsPbBr_3$ Single Crystals

Jianing Hu[a], Fangxiong Tang[b], Yan Zhu[*a,c], Yuzhe Zhang[c], Huaxing Gou[a], Haoyan Ye[b], Siyu Han[b], Hengyong Bu[a], Run Xu[*b,d]

a Faculty of Materials Science and Technology, Kunming University of Science and Technology, Kunming 650093, China.

b State Key Laboratory of Materials for Advanced Nuclear Energy, Shanghai University , Shanghai, 200444, China.

c Shanghai Technical Institute of Electronics & Information, Shanghai 201411, China, Postal address: No. 3098 Wahong Road, Fengcheng Town, Fengxian District, Shanghai, 201411, China.

d Zhejiang Institute of Advanced Materials, SHU, 1588 Huaxiang Street, Jiashan, 314113, China.

Corresponding author:

Yan Zhu (zhuyan@kust.edu.cn), and Run Xu (runxu@staff.shu.edu.cn)

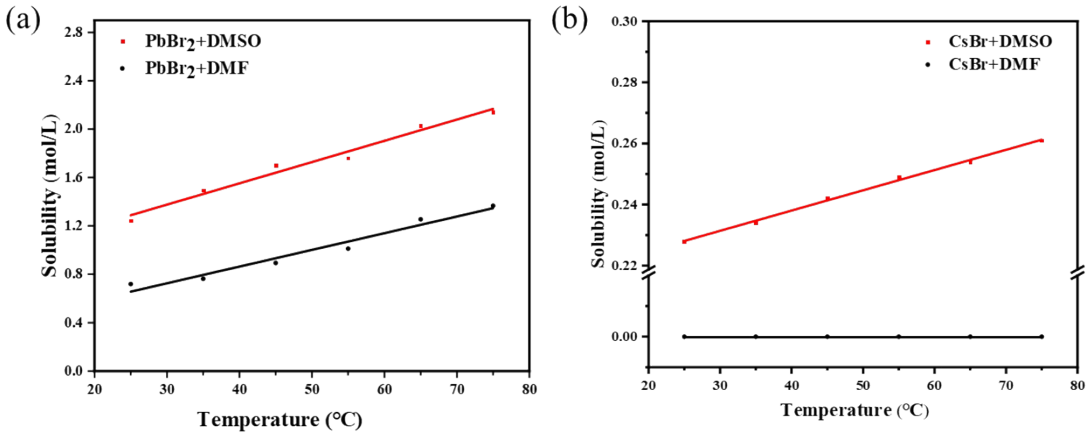


Figure S1. (a) Solubility curves of $PbBr_2$ in DMSO and DMF. (b) Solubility curves of CsBr in DMSO and DMF.

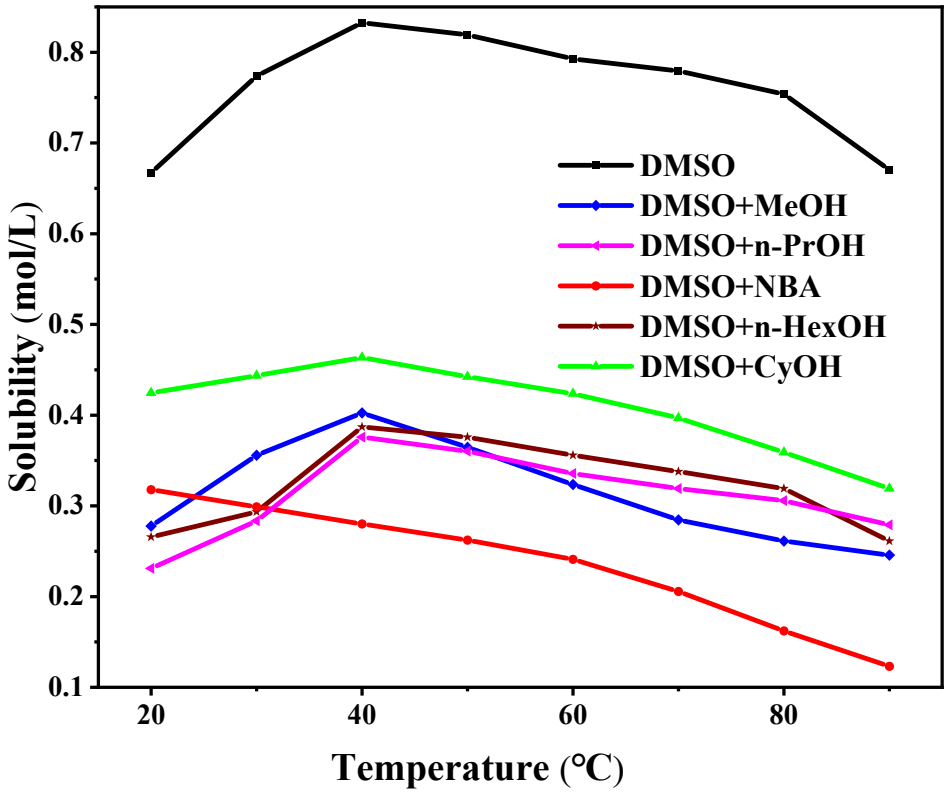


Figure S2. Solubility curves of $CsPbBr_3$ in DMSO and DMSO with different alcohols added.

Table S1 Summary of the growth of $CsPbBr_3$ single crystals.

Reference	Solvent	Additives	Growth method	Growth temperature (^oC)	XRC (^{o})	τ or μτ (ns or cm^2/V)
[1]	DMSO	none	LTC[a]	27-30	none	none
[2]	DMSO	none	ITC[b]	110	none	τ_2=17.03
[3]	DMSO	none	ITC[b]	140	0.043	none
[4]	DMSO	Choline Bromide	ITC[b]	80-85	none	$\mu\tau_e=1.80 \times 10^{-3}$
[5]	DMSO	TMAB	ITC[b]	60-85	none	τ_{ave}=88
[6]	DMSO	Bromoacetic acid	ITC[b]	105	0.07	τ=80
[7]	DMSO	none	ITC[b]	85	none	$\mu\tau_h=9.01 \times 10^{-4}$
[8]	DMSO/DMF	Acetonitrile	ITC[b]	45-60	0.035	$\mu\tau=2.57 \times 10^{-4}$
[9]	DMSO/DMF/CyOH	none	ITC[b]	90-110	none	$\mu\tau=2 \times 10^{-4}$
[10]	DMSO/DMF/CyOH	none	ITC[b]	49.5	none	τ_1 = 2.9; τ_2 = 25.1
[11]	DMSO/DMF/CyOH	none	ITC[b]	50-90	none	none
[12]	DMSO/DMF/CyOH	none	ITC[b]	40-80	none	$\mu\tau= 2.8 \times 10^{-4}$
[13]	DMSO/DMF/CyOH	Choline Bromide	ITC[b]	below 85	0.082	τ_1=0.70 τ_2=6.51
[14]	DMSO/DMF/CyOH	4-bromobutyric acid	ITC[b]	60-85	0.025	$\mu\tau_h=0.57 \times 10^{-4}$
This work	DMSO	n-butanol	ITC[b]	50-85	0.035	$\mu\tau_h=0.67 \times 10^{-4}$

a LTC: Low-temperature crystallization; b ITC: Inverse temperature crystallization

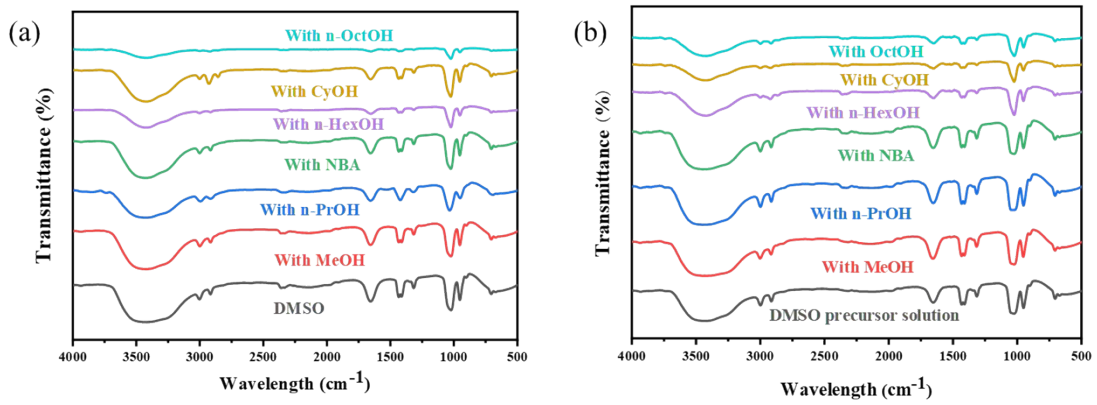


Figure S3. (a) FTIR spectra of different alcohols mixed in DMSO. (b) FTIR spectra of different alcohols mixed in $CsPbBr_3$ precursor solution.

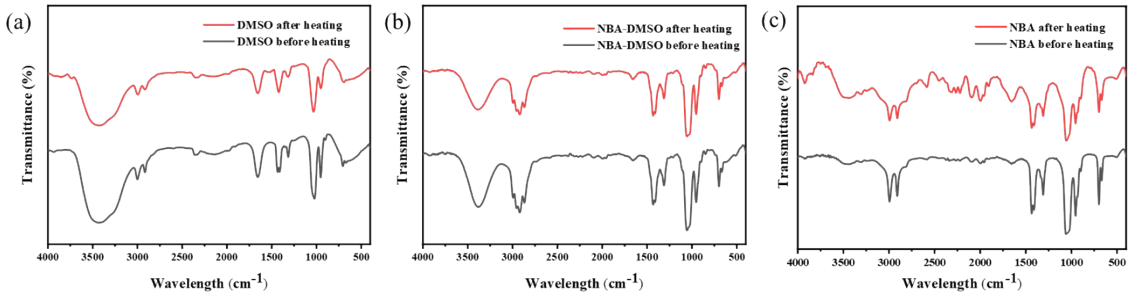
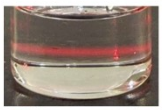
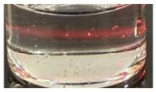


Figure S4. FTIR spectra of different solvents before and after thermal treatment: (a) pure DMSO, (b) NBA in DMSO, and (c) pure NBA.

Table S2 Summary of Tyndall effect in different precursors containing different alcohols at 30℃~70℃.

Temperature	30℃	40℃	50℃	60℃	70℃
DMSO					
DMSO+DMF +CyOH					
DMSO+NBA					

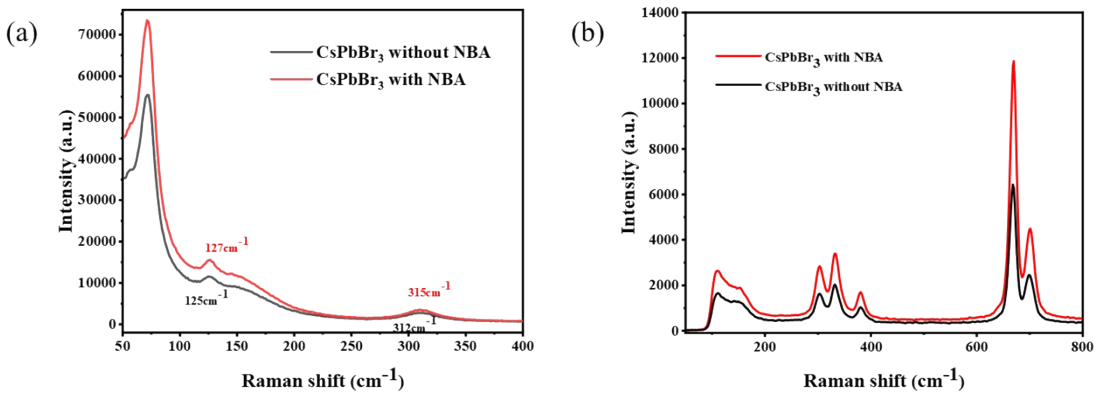


Figure S5. (a) Raman spectra of $CsPbBr_3$ powders synthesized with and without NBA additive. (b) Raman spectra of $CsPbBr_3$ solution grown with or without NBA additive.

Table S3 Key solvent parameters of different alcohols.

Solvent	DN (kcal/mol)	σ (Å)	ε_r (25℃)	μ (D)
Methanol	19	3.6	32.7	1.7
n-Propanol	21.1	4.7	20.5	1.58
n-Butanol	19.5	5.0	17.5	1.66
n-Hexanol	17.4	5.4	13.0	1.60
Cyclohexanol	~20	5.8	15.9	1.85
DMSO	29.8	4.4	46.7	3.96

The data comes from [15-18].

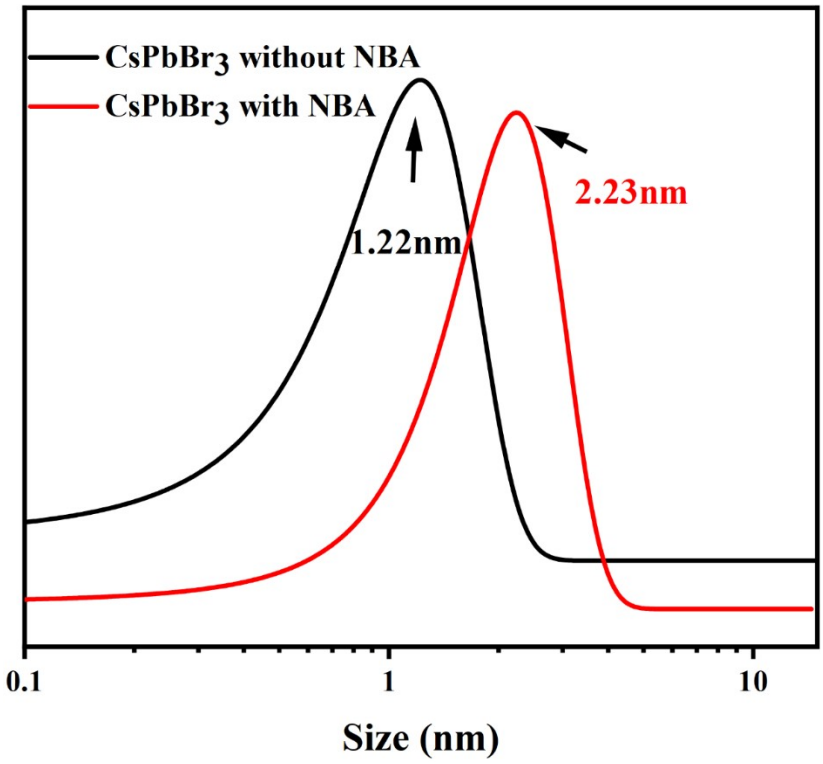


Figure S6. Particle size diagram of $CsPbBr_3$ precursor solution with and without NBA

addition.

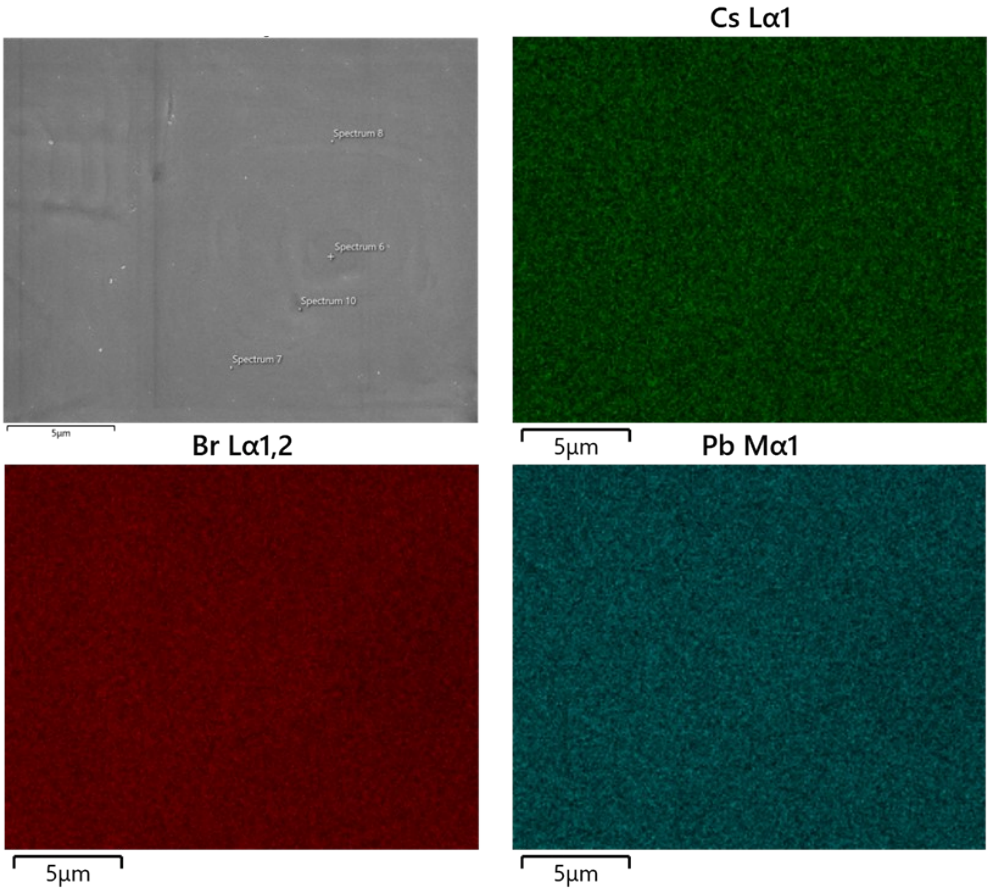


Figure S7. SEM and corresponding EDS elemental mapping images of $CsPbBr_3$ crystal surface.

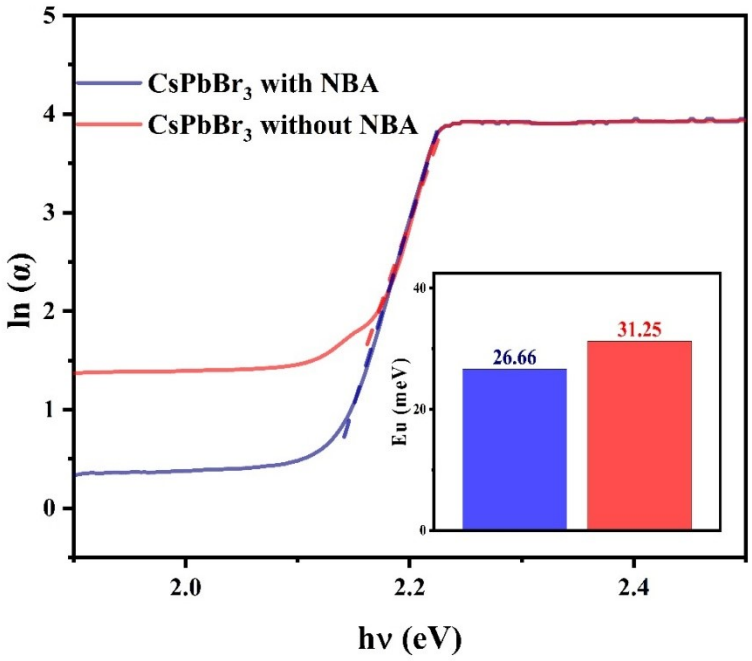


Figure S8. Urbach energy analysis of the $CsPbBr_3$ single crystal grown.

Table S4 Quantitative elemental analysis of $CsPbBr_3$ crystals via EDS point-scan mode.

Element	Spectrum 6		Spectrum 7		Spectrum 9		Spectrum 10		Map Sum Spectrum	
	at.%	ratio	at.%	ratio	at.%	ratio	at.%	ratio	at.%	ratio
Cs	21.64	1	21.48	1	21.63	1	22.05	1	21.30	1
Pb	20.96	0.97	20.78	0.97	20.86	0.96	20.61	0.94	20.60	0.97
Br	57.39	2.65	57.73	2.69	57.51	2.66	57.34	2.60	58.10	2.73
Total	100	$CsPbBr_3$	100	$CsPbBr_3$	100	$CsPbBr_3$	100	$CsPbBr_3$	100	$CsPbBr_3$

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