

Supporting information

Recent advances in synthesis of water-stable metal halide perovskites and photocatalytic applications

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Table S1. Summary of water-stable MHPs for different applications.

Water-stable MHP	Strategy	Applications	Ref.
POSS–CsPbBr ₃ NCs	Ligand engineering	LED	1
Paraffin–CsPbX ₃ QDs	Ligand engineering	LED	2
Paraffin–CsPb _{0.7} Sn _{0.3} Br ₂ I QDs	Ligand engineering	LED	3
CsPbBr ₃ NCs	Water-assisted engineering	LED	4
CsPbBr ₃ –AlSt ₃ NCs	Ligand engineering	LED	5
CsPbBr ₃ –AlSt ₃ QDs	Ligand engineering	LED	6
Norland Optical Adhesives 61/CH ₃ NH ₃ PbBr ₃ film	Organic polymer	LED	7
CsPbBr _{0.6} I _{2.4} QD/Ergos optical adhesive 8500 films	Organic polymer	LED	8
MAPbBr ₃ /phenyl methyl silicon resin (1.13 wt%) NCs	Organic polymer	LED	9
MAPbBr ₃ –polystyrene film	Organic polymer	LED	10
benzyl- dimethyloctadecylammonium chloride (V18)-MAPbBr ₃ NCs	Organic polymer	LED	11
CsPbBr ₃ –poly(methyl methacrylate)	Organic polymer	LED	12
MAPbBr ₃ (8 wt.%) NCs/polyvinylidene fluoride film	Organic polymer	LED	13
Hydrolyzed poly(methyl methacrylate)-coated CH ₃ NH ₃ PbBr ₃	Organic polymer	LED	14
Silicone resin/polyvinylpyrrolidone– CsPbBr ₃ nanofibrous membranes	Organic polymer	LED	15
Polyimide-coated CsPbBr ₃ NCs	Organic polymer	LED	16
superhydrophobic aerogel inorganic matrix (S-AIM)/CsPbBr ₃ QDs	Inorganic materials	LED	17

CsPbBr ₃ QDs/mesoporous silica aerogels	Inorganic materials	LED	18
Mesoporous SiO ₂ -CsPbBr ₃ @AlO _x	Inorganic materials	LED	19
MAPbBr ₃ @SiO ₂ /poly(vinylidene fluoride) nanoparticles	Organic polymer and inorganic materials	LED	20
CsPbI ₃ @polystyrene@SiO ₂	Organic polymer and inorganic materials	LED	21
CsPbBr ₃ /SiO ₂	Inorganic materials	LED	22
CsPbBr ₃ /ZrO ₂ -10	Inorganic materials	LED	23
Mn-doped CsPbCl ₃ -SiO ₂ /Al ₂ O ₃ monolith	Inorganic materials	LED	24
CsPbBr ₃ QDs@SiO ₂	Inorganic materials	LED	25
CsPbBr _{1.2} /I _{1.8} NCs@P-Si-Zn glass	Inorganic materials	LED	26
Ni ²⁺ -doped CsPbBr ₃ NCs@B-Si-Zn glass	Inorganic materials	LED	27
CsPbBr ₃ QDs@TeO ₂ -based glass	Inorganic materials	LED	28
(CsPbI ₃) _{0.25} (a _g ZIF-62) _{0.75}	Inorganic materials	LED	29
CsPbBr ₃ /SiO ₂	Inorganic materials	LED	30
MAPbBr ₃ @PbBr(OH)	Water-assisted engineering	LED	31
MAPbBr ₃ @PbBr(OH)	Water-assisted engineering	LED	32
MAPbBr ₃ @PbBr(OH)	Water-assisted engineering	LED	33
CsPbBr ₃ /CsPb ₂ Br ₅ @PbBr(OH)	Water-assisted engineering and phase engineering	LED	34
CsPb ₂ Br ₅ -embedded Pb(OH)Br	Water-assisted engineering and phase engineering	LED	35
Trifluoromethyl-modified PEA ₂ PbBr ₄	Intrinsic stability	LED	36
4,4'-trimethylenedipyridinium lead bromide crystals [(4,4'-TMDP)Pb ₂ Br ₆] and 4,4'-ethylenedipyridinium lead bromide crystals [(4,4'-EDP)Pb ₂ Br ₆]	Intrinsic stability	LED	37

Solid lipid nanoparticles- CsPb(Br _{0.2} I _{0.8}) ₃	Ligand engineering	Water stability	38
CsPbBr ₃ NCs-PMA	Organic polymer	Water stability	39
MAPbX ₃ NCs- polystyrene-poly(2- vinylpyridine) (PS-b-P2VP)	Organic polymer	Water stability	40
CsPbBr ₃ QDs-poly(styrene-ethylene- butylene-styrene) films	Organic polymer	Water stability	41
CsPbX ₃ QDs/AlO _x films	Inorganic materials	Water stability	42
Cs ₂ Sn _{0.89} Te _{0.11} Cl ₆	Inorganic materials	Water stability	43
CsPbBr ₃ @SiO ₂ NPs	Inorganic materials	Water stability	44
PEGylated CsPbBr ₃ /SiO ₂ QDs	Inorganic materials	Water stability	45
CsPbBr ₃ @NaYF ₄ and CsPbBr ₃ @ZnO nanoparticles	Inorganic materials	Water stability	46
CsPbBr ₃ /CsPb ₂ Br ₅	Phase engineering	Water stability	47
Sb ³⁺ -doped dual-phase CsPb ₂ Br ₅ /CsPbBr ₃ NCs	Phase engineering	Water stability	48
CsPbX ₃ NCs	Water-assisted engineering	Water stability	49
quasi-2D CsPbBr ₃ NSs	Water-assisted engineering	Water stability	50
Pb(OH) ₂ -coated MAPbX ₃	Water-assisted engineering	Water stability	51
CsPbBr ₃ /PbBrF	Water-assisted engineering	Water stability	52
[Pb ₂ X ₂ ²⁺] [O ₂ C(CH ₂) ₄ CO ₂ ⁻] crystals	Intrinsic stability	Water stability	53
(C ₄ H ₉) ₄ NCuCl ₂ single crystals	Intrinsic stability	Water stability	54
Mn-doped 2D (PEA) ₂ PbBr ₄ crystals	Intrinsic stability	Water stability	55
(HCya) ₂ PbI ₄ (Cya = HS(CH ₂) ₂ NH ₂) crystals	Intrinsic stability	Water stability	56
[N-methylidabconium]PbI ₃ crystals	Intrinsic stability	Water stability	57
(DAO)Sn ₂ I ₆ (DAO = 1,8- octyldiammonium) crystals	Intrinsic stability	Water stability	58

$\text{Rb}_{0.05}\text{Cs}_{2.95}\text{Bi}_2\text{I}_9$	Intrinsic stability	Water stability	59
Hexafluorobutyl methacrylate-coated $\text{Co}_{2\%}\text{@CsPbBr}_3/\text{Cs}_4\text{PbBr}_6$ NCs	Ligand engineering	Photocatalysis	60
$\text{MAPbBr}_3\text{@ZIF-8}$	MOF	Photocatalysis	61
$\text{CsPbI}_3\text{@PCN-222}$ (20%)	MOF	Photocatalysis	62
Pb-rich CsPbCl_3 nanocrystals	Water-assisted engineering	Photocatalysis	63
$[(\text{CH}_3)_2\text{NH}_3]_3[\text{BiI}_6]$	Common-ion effect	Photocatalysis	64
$\text{C}_6\text{H}_5\text{CH}_2\text{NH}_3\text{PbI}_4$, $\text{C}_6\text{H}_5(\text{CH}_2)_2\text{NH}_3\text{PbI}_4$ and with $\text{C}_6\text{H}_5(\text{CH}_2)_3\text{NH}_3\text{Pb}_2\text{I}_7$	Common-ion effect	Photocatalysis	65
$\text{OHNH}_3\text{PbI}_2\text{Cl}$	Intrinsic stability	Photocatalysis	66
DMASnI_3	Intrinsic stability	Photocatalysis	67
$(\text{HDA})_2\text{PbI}_4$ [$\text{HDA}^+=\text{CH}_3(\text{CH}_2)_{15}\text{NH}_3^+$]	Intrinsic stability	Photocatalysis	68
$\text{DMASnI}_x\text{Br}_{3-x}$ crystals	Intrinsic stability	Photocatalysis	69
$\{\text{C}_6\text{H}_5(\text{CH}_2)_2\text{NH}_3\}_2\text{SnBr}_4$ ($\text{PEA}_2\text{SnBr}_4$)	Intrinsic stability	Photocatalysis	70
$[\text{Pb}_2\text{X}_2^{2+}]$ [$\text{O}_2\text{C}(\text{CH}_2)_4\text{CO}_2^-$] crystals	Intrinsic stability	Photocatalysis	71
$(3\text{-ethylbenzo[d]thiazol-3-ium})_4\text{Bi}_2\text{I}_{10}$ ($\text{EtbTbi}_2\text{I}_{10}$) single crystals	Intrinsic stability	Photocatalysis	72
$\text{C}_6\text{H}_4\text{NH}_2\text{CuCl}_2\text{I}$	Intrinsic stability	Photocatalysis	73
33 wt % $\text{DMASnBr}_3\text{@g-C}_3\text{N}_4$	Intrinsic stability	Photocatalysis	74
$\text{CsPbBr}_3\text{@g-C}_3\text{N}_4$	Intrinsic stability	Photocatalysis	75
DMASnBr_3	Intrinsic stability	Photocatalysis	76
$\text{Cs}_3\text{Bi}_2\text{Br}_9/\text{g-C}_3\text{N}_4$	Intrinsic stability	Photocatalysis	77
$\text{Cs}_2\text{Pt}_x\text{Sn}_{1-x}\text{Cl}_6$	Intrinsic stability	Photocatalysis	78
$\text{Au}_{0.19}/[\text{Pb}_8\text{I}_8(\text{H}_2\text{O})_3]^{8+}[\text{O}_2\text{C}(\text{CH}_2)_4\text{CO}_2^-]$ 4-	Intrinsic stability	Photocatalysis	79
$\text{C}_6\text{F}_{13}\text{CH}_2\text{CH}_2\text{Si}(\text{OCH}_2\text{CH}_3)_3$ (PFOTHS)- $\text{CsPbBr}_3/\text{Cs}_4\text{PbBr}_6/\text{BaSO}_4$	Ligand engineering	Imaging	80

CsPbBr ₃ QDs@polystyrene	Organic polymer	Imaging	81
Polyvinyl pyrrolidone-capped CsPbX ₃ NCs@polystyrene microhemispheres	Organic polymer	Imaging	82
Poly(ethylene-ran-butylene)-block-polystyrene (PS-PEB-PS) and poly(ethylene glycol)-block-poly(propylene glycol)-block-poly(ethylene glycol (PEG-PPG-PEG) coated CsPbBr ₃ QDs	Organic polymer	Imaging	83
CsPbBr ₃ /SiO ₂ /poly(ethylene glycol) grafted phospholipid	Inorganic materials and organic polymer	Imaging	84
phTEOS-TMOS@CsPbBr ₃ NCs	Inorganic materials	Imaging	85
Polyvinyl pyrrolidone-CsPbBr ₃ QD@SiO ₂ -octadecyl trimethoxysilanelecithin core-shell nanoparticles	Inorganic materials	Imaging	86
1D Nanowire, 2D Nanoplatelet, and 3D Nanocube CsPbBr ₃ NCs	Water-assisted engineering	Imaging	87
Pb(OH) ₂ -coated MAPbX ₃	Water-assisted engineering	Imaging	88
CsPbBr ₃ @PCN-333(Fe)	MOF	(Photo)electrochemical application	89
4-[(N-3-butyl)carboxyamido]anilinium lead(II) iodide (NBCAnPbI ₃)/CH ₃ NH ₃ PbI ₃	Intrinsic stability	(Photo)electrochemical application	90
APbX ₂ (A = Bipyridine) crystals	Intrinsic stability	(Photo)electrochemical application	91
Cs ₂ PtI ₆	Intrinsic stability	(Photo)electrochemical application	92
CsPbBr ₃ /polypyrrole	Organic polymer	(Photo)electrochemical application	93
CsPbBr ₃ /polyaniline	Organic polymer	(Photo)electrochemical application	94
CsPbBr ₃ /TiO _x	Inorganic materials	(Photo)electrochemical	95

		application	
CsPbBr ₃	Water-assisted engineering	(Photo)electrochemical application	96
Succinic acid-capped CsPbBr ₃ QDs	Ligand engineering	Sensor	97
CsPbBr ₃ /Cs ₄ PbBr ₆ NCs-Hyflon-DFTHS/OLA	Organic polymer	Sensor	98
CsPbBr ₃ /octylamine-modified polyacrylic acid + OAm NCs	Organic polymer	Sensor	99
CH ₃ NH ₃ PbBr ₃ @MOF-5	MOF	Sensor	100
CsPbX ₃ /hierarchically porous ZIF-8	MOF	Sensor	101
MAPbBr ₃ @PbBr(OH)@SiO ₂ -citric acid -Eu	Water-assisted engineering and inorganic material	Sensor	102
[(AD)Pb ₂ Cl ₅] (AD = acridine) microbelts	Intrinsic stability	Sensor	103
(C ₄ H ₉) ₄ NPbI ₃	Intrinsic stability	Solar cell	104
Crosslinked PETA-G/FA _{0.92} MA _{0.08} PbI ₃ films	Organic polymer	Solar cells	105
C ₆ H ₄ NH ₂ CuBr ₂ I	Intrinsic stability	Solar cell	106
C ₆ H ₄ NH ₂ CuBr ₂ I	Intrinsic stability	Solar cell	107
CH ₃ NH ₃ Pb(SCN)2I	Intrinsic stability	Solar cell	108
CsPbBr ₃ QDs-HSZ ZSM-5	Inorganic materials	Fingerprint detection	109
MAPbBr ₃ @PbBr(OH)	Water-assisted engineering	Fingerprint detection	31
MAPbBr ₃ @PbBr(OH)	Water-assisted engineering	Anticounterfeit	32
Al ₂ O ₃ coated CsPbBr ₃ nanoplate	ALD	Laser	110
CsPbBr ₃ QDs@SiO ₂ -SH nanodots	Inorganic materials	Laser	111

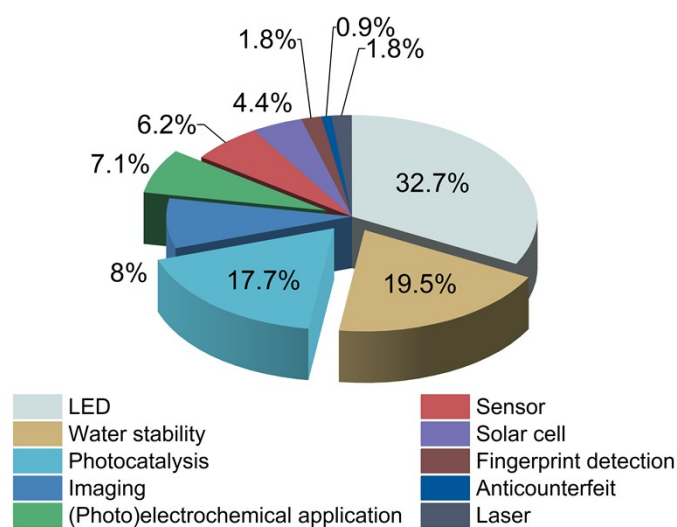


Figure S1. Pie chart showing the application distribution of water-stable MHPs.

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