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

Table S1 The bond length of Ce-O in (Ca, Mg, Sr, Ba)$_9$Ce(PO$_4$)$_7$.

	$Ca_9Ce(PO_4)_7$	$Ca_{8.4}Mg_{0.6}Ce(PO_4)_7$	$Ca_{8.4}Sr_{0.6}Ce(PO_4)_7$	$Ca_{8.4}Ba_{0.6}Ce(PO_4)_7$
Ce-O6	2.267	2.375	4.207	4.420
Ce-O6	2.267	2.375	4.207	4.420
Ce-O6	2.267	2.375	4.207	4.420
Ce-O9	2.339	2.538	2.510	2.465
Ce-O9	2.339	2.538	2.510	2.465
Ce-O9	2.339	2.538	2.510	2.465
Average value (Å)	2.303	2.456	3.358	3.442

Table S2 Side length of [Ce-O] polyhedron in (Ca, Mg, Sr, Ba)$_9$Ce(PO$_4$)$_7$.

Distance of O_i-O_j in [Ce-O] polyhedron in $Ca_{8.4}Ce(PO_4)_7$:0.6RE (Å)	RE=Ca^{2+}	RE=Mg^{2+}	RE=Sr^{2+}	RE=Ba^{2+}
O9-O9	3.343	2.816	4.096	2.831
O9-O9	3.343	2.816	4.096	2.831
O9-O9	3.343	2.816	4.096	2.831
O6-O6	2.549	5.660	6.804	7.342
O6-O6	2.549	5.660	6.804	7.342
O6-O6	2.549	5.660	6.804	7.342
O6-O9	3.623	3.994	4.238	4.556
O6-O9	3.623	3.994	4.238	4.556
O6-O9	3.623	3.994	4.238	4.556
O6-O9	3.404	3.961	4.067	5.118
O6-O9	3.404	3.961	4.067	5.118
O6-O9	3.404	3.961	4.067	5.118
Standard Deviation	0.406	1.013	1.158	1.612

Table S3 The bond length of Eu-O in $(Ca, Mg, Sr, Ba)_{8.94}Ce(PO_4)_7:0.06Eu^{2+}$.

Distance of Ca3/Eu3-O_i in [Ca3/Eu3-O] polyhedron in $Ca_{8.34}Ce(PO_4)_7:0.06Eu^{2+}$, 0.6RE (Å)	RE=Ca^{2+}	RE=Mg^{2+}	RE=Sr^{2+}	RE=Ba^{2+}
O1	3.066	2.722	3.122	3.025
O2	3.377	1.360	---	3.054
O3	2.972	2.746	2.947	3.130
O3	---	---	---	2.853
O4	---	2.370	2.845	2.967
O4	---	---	2.95	---
O5	3.205	2.804	3.237	2.728
O6	3.231	---	2.741	2.745
O6	3.011	---	---	---
O7	2.578	2.634	2.647	2.500
O8	---	2.483	1.183	---
O9	3.486	---	---	---
O10	1.875	2.444	1.998	1.988
O10	---	2.576	---	---
Average value (Å)	2.977	2.459	2.630	2.776

Note：”---” represents there is no connection between Ca3/Eu3 and the corresponding oxygen.

Table S4 The bond length of Mn-O in $(Ca, Mg, Sr, Ba)_{8.84}Ce(PO_4)_7:0.16Mn^{2+}$.

Distance of Ca3/Mn3-O_i in [Ca3/Mn3-O] polyhedron in $Ca_{8.24}Ce(PO_4)_7:0.16Mn^{2+}$,0.6RE (Å)	RE=Ca^{2+}	RE=Mg^{2+}	RE=Sr^{2+}	RE=Ba^{2+}
O1	2.667	2.732	2.636	3.334
O2	3.605	3.678	3.001	---
O3	2.95	1.68	2.903	2.516
O4	2.516	1.781	2.381	2.857
O5	2.323	2.449	2.546	2.506
O6	---	---	---	2.396
O7	2.537	2.366	2.353	2.258
O8	2.056	2.577	2.586	2.198
O10	2.395	2.685	2.314	2.723
O10	2.621	2.674	2.86	2.867
Average value (Å)	2.630	2.513	2.620	2.628

Note：”---” represents there is no connection between Ca3/Mn3 and the corresponding oxygen.

Table S5 The side length of [Eu-O] polyhedron in (Ca, Mg, Sr, Ba)$_{8.94}$Ce(PO$_4$)$_7$:0.06Eu^{2+}.

Distance of O_i-O_j in [Ca3/Eu3-O] polyhedron in CCPO:0.06Eu^{2+} (Å)		Distance of O_i-O_j in [Ca3/Eu3-O] polyhedron in CCPO:0.06Eu^{2+}, 0.6Mg^{2+} (Å)		Distance of O_i-O_j in [Ca3/Eu3-O] polyhedron in CCPO:0.06Eu^{2+}, 0.6Sr^{2+} (Å)		Distance of O_i-O_j in [Ca3/Eu3-O] polyhedron in CCPO:0.06Eu^{2+}, 0.6Ba^{2+} (Å)	
O5-O6	2.2823	O7-O8	2.8502	O10-O7	2.5771	O4-O5	3.1716
O5-O9	4.7117	O7-O10	2.9019	O10-O6	2.6506	O4-O6	3.6819
O5-O1	4.3545	O7-O1	3.9123	O10-O1	2.8886	O4-O1	4.1767
O5-O6	4.2700	O7-O3	2.8636	O8-O7	3.4168	O4-O10	2.6711
O2-O6	3.8226	O8-O2	2.2849	O8-O3	2.9322	O4-O3	2.9837
O2-O9	3.8900	O8-O10	2.9762	O8-O1	2.5813	O5-O6	1.6237
O2-O6	4.7549	O8-O1	4.1729	O7-O3	3.8633	O5-O3	3.128
O2-O7	2.6409	O8-O3	4.0277	O7-O4	3.2376	O5-O1	4.0495
O2-O3	1.8868	O2-O4	2.4614	O7-O6	3.3293	O6-O3	1.8754
O6-O9	3.7781	O2-O10	3.3631	O7-O1	5.0687	O6-O3	4.3305
O6-O6	4.6995	O2-O5	3.8542	O3-O4	2.2516	O6-O2	3.5116
O6-O3	2.4372	O2-O3	2.1412	O3-O4	4.507	O3-O1	5.5807
O9-O1	4.4267	O4-O10	2.8933	O3-O5	4.1366	O3-O2	2.3574
O9-O7	4.6807	O4-O5	3.3549	O3-O1	5.4949	O1-O10	2.7444
O9-O3	2.4804	O4-O3	1.9658	O4-O4	3.4675	O1-O7	4.6392
O1-O6	5.0603	O10-O1	2.3397	O4-O5	2.5121	O1-O2	5.7903
O1-O7	4.8551	O10-O5	3.3508	O4-O6	0.9066	O10-O3	2.5139
O1-O10	2.7273	O10-O3	3.5154	O4-O5	4.0862	O10-O7	2.5067
O6-O7	3.4713	O10-O1	2.3398	O6-O5	4.087	O3-O7	1.9736
O6-O3	5.1203	O10-O5	2.5911	O6-O1	4.6951	O3-O2	3.7443
O6-O10	2.9551	O1-O5	2.4452	O5-O1	4.1917	O7-O2	2.7901
O7-O10	2.522						
Standard Deviation	1.024		0.641		1.047		1.108

Table S6 The side length of [Mn-O] polyhedron in $(Ca, Mg, Sr, Ba)_{8.84}Ce(PO_4)_7$:0.16$Mn^{2+}$.

Distance of O_i-O_j in [Ca3/Mn3-O] polyhedron in CCPO:0.16Mn^{2+} (Å)		Distance of O_i-O_j in [Ca3/Mn3-O] polyhedron in CCPO:0.16Mn^{2+}, 0.6Mg^{2+} (Å)		Distance of O_i-O_j in [Ca3/Mn3-O] polyhedron in CCPO:0.16Mn^{2+}, 0.6Sr^{2+} (Å)		Distance of O_i-O_j in [Ca3/Mn3-O] polyhedron in CCPO:0.16Mn^{2+}, 0.6Ba^{2+} (Å)	
O4-O5	2.7686	O7-O10	2.7885	O1-O10	2.6543	O10-O7	2.1522
O4-O3	2.2068	O7-O8	3.3834	O1-O8	3.4997	O10-O1	3.3883
O4-O2	3.4803	O7-O4	2.7948	O1-O10	2.6542	O10-O6	2.8642
O10-O7	2.5496	O7-O1	3.481	O1-O2	2.5245	O10-O4	3.1202
O10-O1	2.4457	O7-O2	4.1086	O4-O5	2.7142	O8-O7	2.5024
O10-O3	3.2108	O10-O4	2.7259	O4-O7	3.6302	O8-O10	2.5031
O10-O2	3.3316	O10-O5	3.8829	O4-O10	3.2449	O8-O1	4.4772
O7-O1	3.9916	O10-O1	2.6241	O4-O3	4.2094	O8-O3	3.0599
O7-O8	2.408	O8-O10	1.8905	O4-O2	2.8126	O8-O4	4.0322
O7-O10	4.3143	O8-O1	3.2526	O10-O5	3.0166	O7-O1	4.3465
O7-O3	2.4611	O8-O2	2.5418	O10-O8	2.1977	O7-O4	2.4873
O1-O10	2.4457	O4-O3	2.779	O10-O3	2.9499	O10-O1	3.3891
O1-O2	3.1495	O4-O5	3.2867	O10-O2	3.7726	O10-O5	3.1062
O5-O8	3.0856	O4-O2	4.5865	O5-O3	2.631	O10-O3	4.0845
O5-O10	3.2466	O10-O5	2.4454	O5-O2	3.2874	O1-O5	3.9159
O5-O2	3.9653	O10-O1	2.6241	O7-O8	2.8527	O1-O6	3.764
O8-O10	3.3317	O10-O2	4.0308	O7-O10	2.6835	O5-O6	2.7115
O8-O3	3.1584	O3-O5	2.3856	O7-O3	4.1959	O5-O3	3.1506
O10-O2	4.6252	O3-O2	2.7698	O8-O10	4.4139	O6-O3	3.6515
O3-O2	5.0654	O5-O1	3.2775	O8-O3	3.0501	O6-O4	2.8279
				O10-O2	3.1673	O3-O4	2.8827
Standard Deviation	0.772		0.660		0.590		0.642

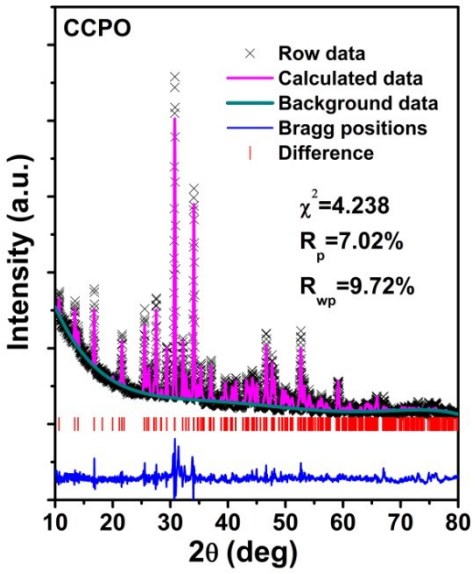

Figure S1 Rietveld refinement of powder XRD profiles of CCPO

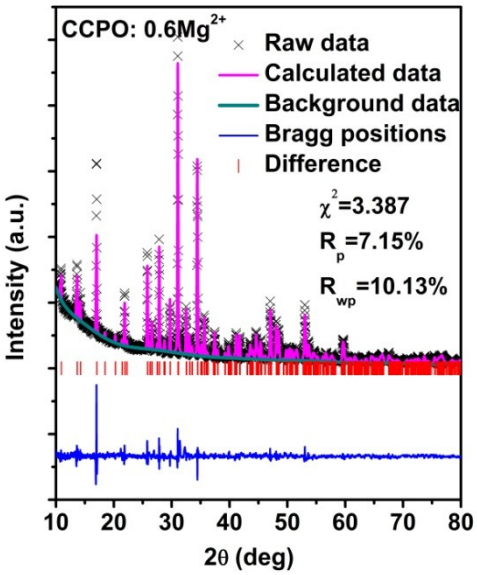

Figure S2 Rietveld refinement of powder XRD profiles of CCPO:0.6Mg^{2+}

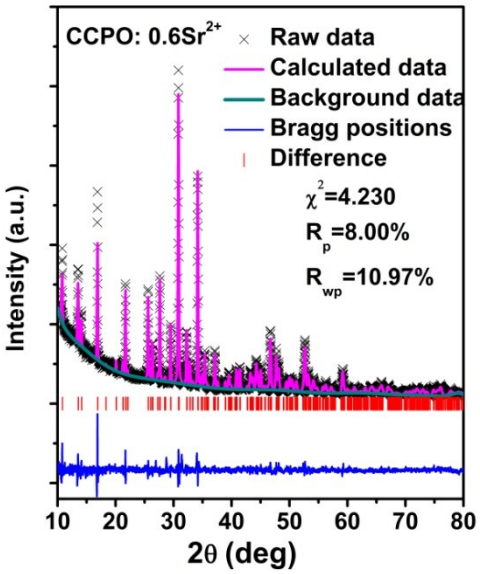

Figure S3 Rietveld refinement of powder XRD profiles of CCPO:0.6Sr^{2+}

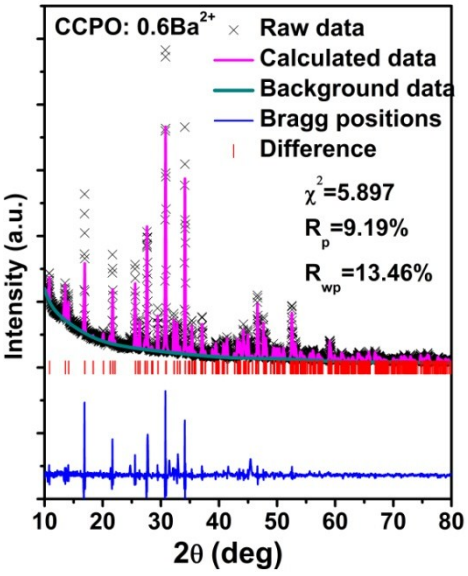

Figure S4 Rietveld refinement of powder XRD profiles of CCPO:0.6Ba^{2+}

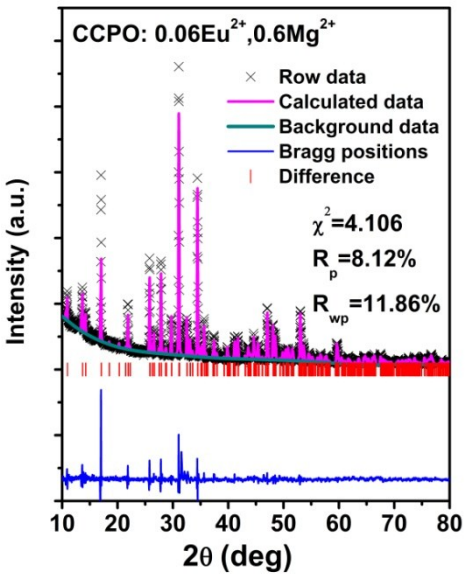

Figure S5 Rietveld refinement of powder XRD profiles of CCPO:0.06Eu^{2+},0.6Mg^{2+}

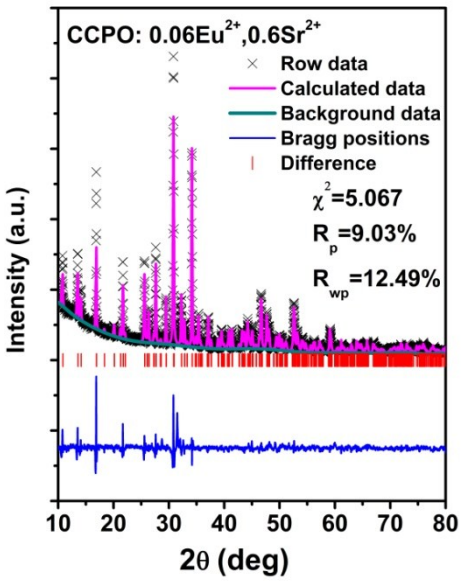

Figure S6 Rietveld refinement of powder XRD profiles of CCPO:0.06Eu^{2+},0.6Sr^{2+}

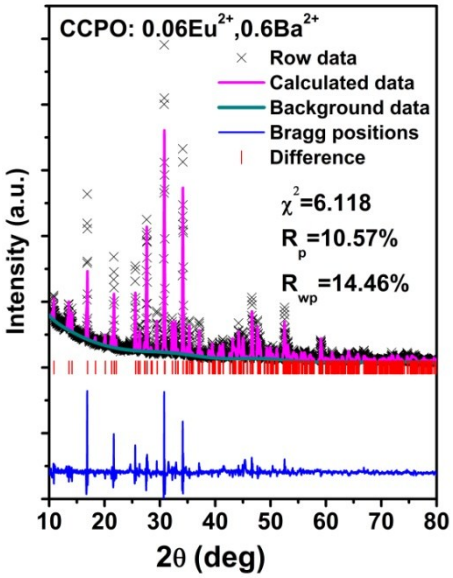

Figure S7 Rietveld refinement of powder XRD profiles of CCPO:0.06Eu^{2+},0.6Ba^{2+}

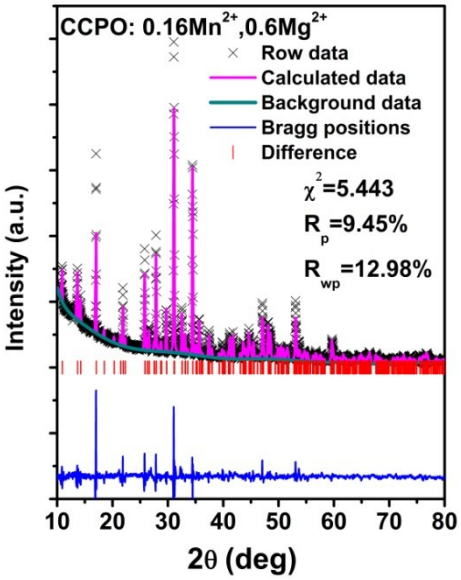

Figure S8 Rietveld refinement of powder XRD profiles of CCPO:0.16Mn^{2+},0.6Mg^{2+}

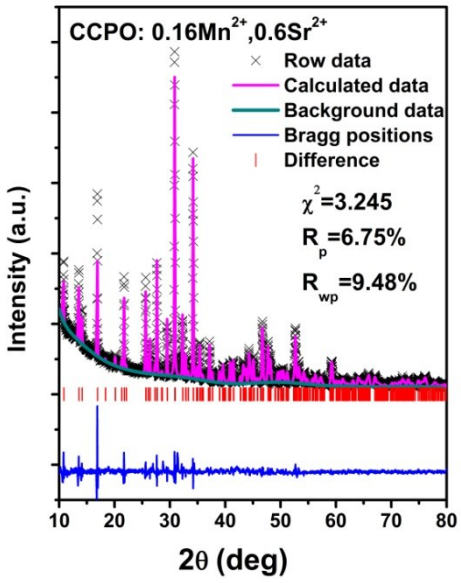

Figure S9 Rietveld refinement of powder XRD profiles of CCPO:0.16Mn^{2+},0.6Sr^{2+}

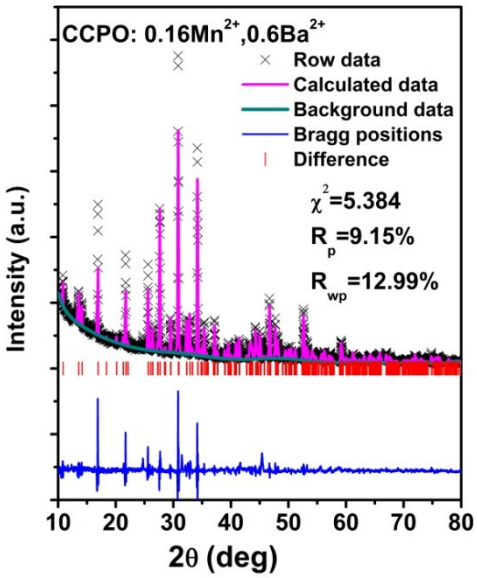

Figure S10 Rietveld refinement of powder XRD profiles of CCPO:0.16Mn^{2+},0.6Ba^{2+}