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**Supporting information for article:**

**Perovskite-related structures of  $\text{Ba}_2\text{YAIO}_5$  and the  $\beta$  and  $\alpha$  phases of  $\text{Ba}_6\text{Y}_2\text{Al}_4\text{O}_{15}$  containing  $\text{AlO}_4$  tetrahedra**

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**Table S1**Atomic displacement parameters ( $\text{\AA}^2$ ) for  $\text{Ba}_2\text{YAlO}_5$ 

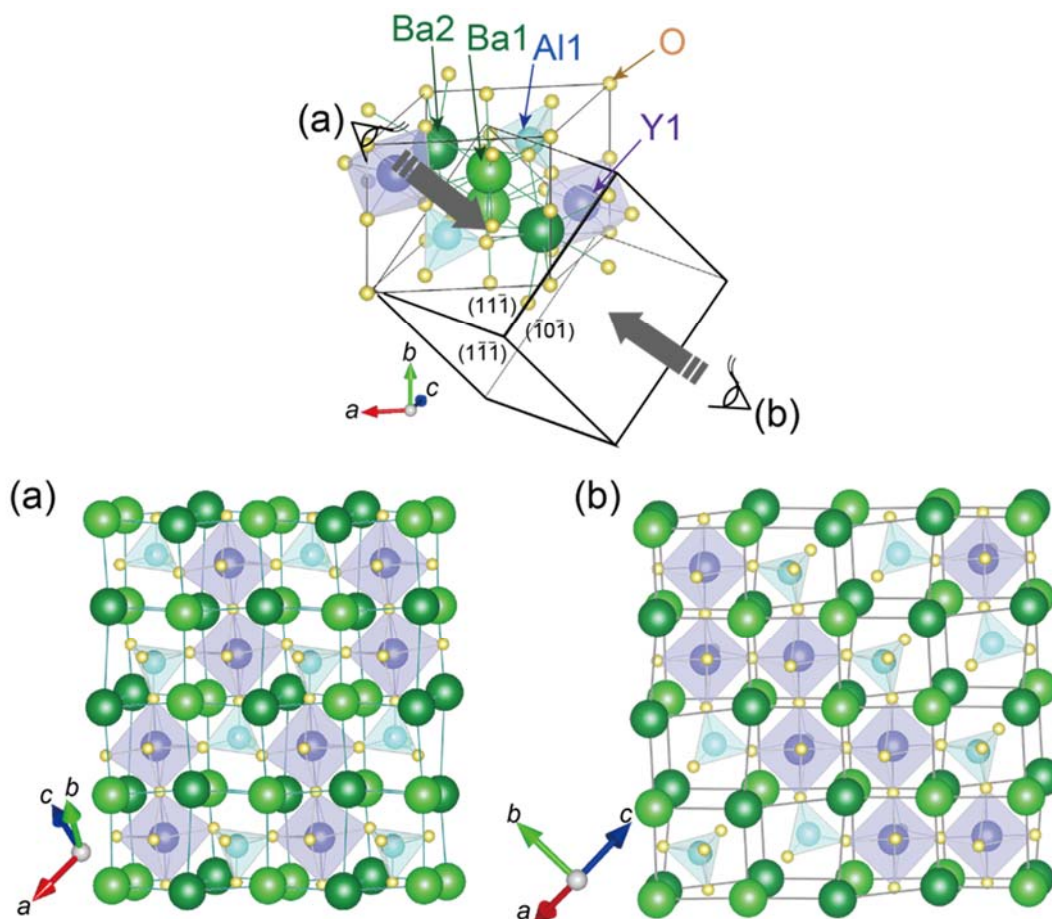
	$U^{11}$	$U^{22}$	$U^{33}$	$U^{12}$	$U^{13}$	$U^{23}$
Ba1	0.0059 (3)	0.0086 (3)	0.0063 (3)	0	0.0024 (2)	0
Ba2	0.0093 (3)	0.0078 (3)	0.0062 (3)	0	0.0028 (2)	0
Y1	0.0062 (4)	0.0035 (4)	0.0049 (4)	0	0.0030 (4)	0
Al1	0.0059 (13)	0.0095 (14)	0.0023 (13)	0	0.0011 (12)	0
O1	0.0212 (15)	0.0212 (15)	0.0207 (15)	0.0032 (9)	0.0090 (10)	-0.0024 (9)
O2	0.010 (3)	0.016 (4)	0.010 (4)	0	0.003 (3)	0
O3	0.007 (3)	0.014 (4)	0.008 (4)	0	0.000 (3)	0
O4	0.022 (2)	0.023 (2)	0.023 (2)	-0.0012 (10)	0.0096 (12)	0.0011 (10)

Atomic displacement parameters ( $\text{\AA}^2$ ) for  $\beta\text{-Ba}_6\text{Y}_2\text{Al}_4\text{O}_{15}$ 

	$U^{11}$	$U^{22}$	$U^{33}$	$U^{12}$	$U^{13}$	$U^{23}$
Ba1	0.0078 (3)	0.0064 (3)	0.0084 (3)	0.0005 (4)	0.0012 (2)	0.0001 (2)
Ba2	0.0069 (2)	0.0067 (3)	0.0077 (3)	0.0005 (4)	0.0006 (2)	0.00076 (18)
Ba3	0.0092 (4)	0.0080 (4)	0.0094 (4)	0	0.0038 (4)	0
Ba4	0.0105 (3)	0.0057 (4)	0.0078 (4)	0	-0.0031 (3)	0
Y1	0.0070 (4)	0.0033 (5)	0.0047 (5)	-0.0007 (7)	-0.0001 (3)	0.0001 (4)
Al1	0.0047 (11)	0.0045 (14)	0.0062 (16)	-0.0005 (15)	0.0023 (11)	0.0008 (10)
Al2	0.0055 (12)	0.0038 (15)	0.0048 (15)	-0.0011 (16)	0.0016 (11)	-0.0003 (14)
O1	0.009 (3)	0.010 (3)	0.011 (4)	0.001 (4)	-0.001 (3)	0.001 (3)
O2	0.010 (4)	0.007 (3)	0.005 (3)	0.002 (3)	0.002 (4)	0.001 (2)
O3	0.014 (4)	0.006 (4)	0.005 (3)	0.001 (4)	0.000 (4)	0.002 (3)
O4	0.009 (4)	0.008 (4)	0.006 (4)	0.000 (4)	-0.002 (3)	0.003 (3)
O5	0.013 (4)	0.007 (4)	0.008 (4)	0.000 (3)	-0.001 (3)	-0.005 (3)
O6	0.012 (3)	0.016 (4)	0.011 (4)	0.002 (3)	0.005 (3)	-0.001 (3)
O7	0.007 (3)	0.011 (3)	0.014 (4)	-0.001 (4)	-0.001 (3)	0.000 (3)
O8	0.007 (4)	0.010 (5)	0.012 (5)	0	0.001 (4)	0

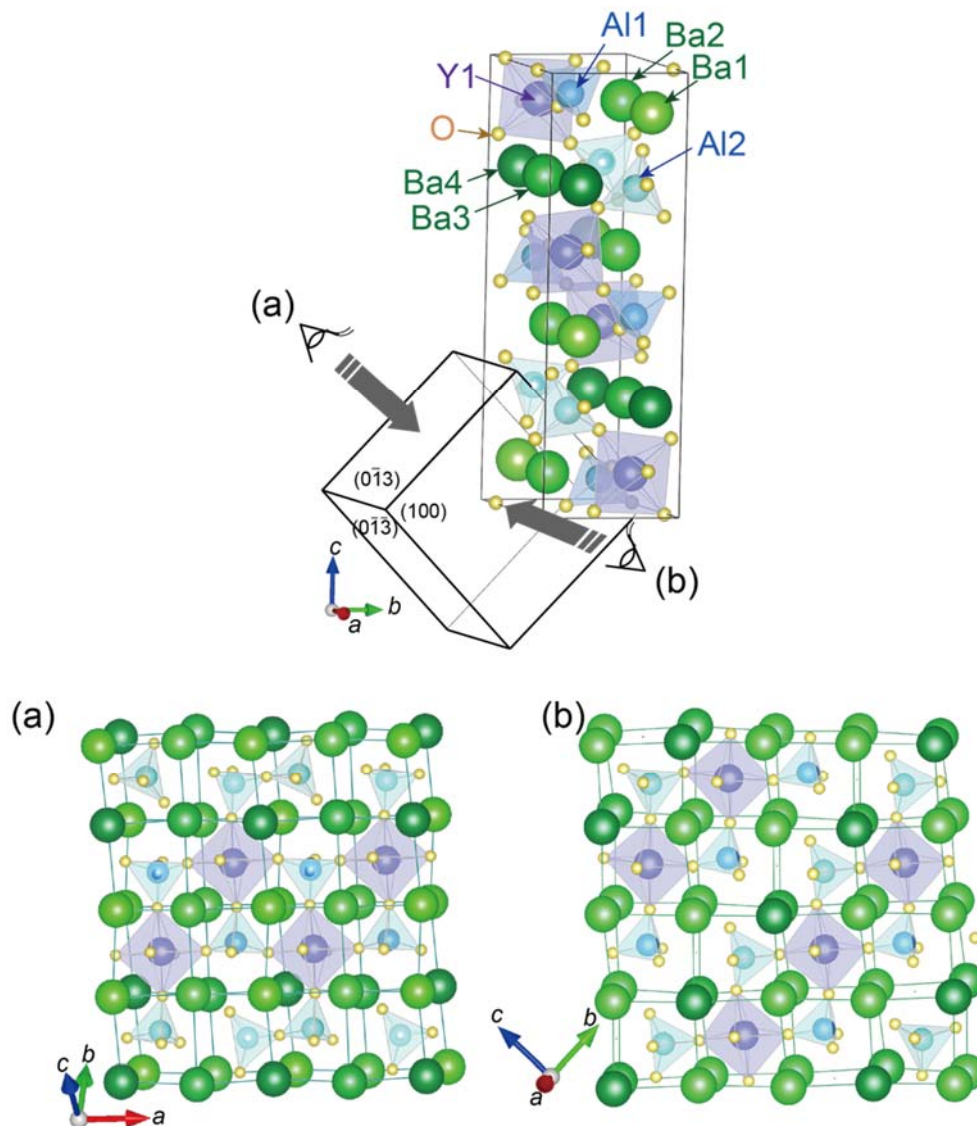
Atomic displacement parameters ( $\text{\AA}^2$ ) for  $\alpha\text{-Ba}_6\text{Y}_2\text{Al}_4\text{O}_{15}$ 

	$U^{11}$	$U^{22}$	$U^{33}$	$U^{12}$	$U^{13}$	$U^{23}$
Ba1	0.0151 (11)	0.0228 (7)	0.0240 (9)	0.0051 (8)	0.0067 (6)	0.0171 (8)
Ba2	0.0081 (9)	0.0238 (7)	0.0217 (6)	0.0032 (7)	0.0073 (5)	0.0101 (7)
Ba3	0.0262 (8)	0.0161 (3)	0.0110 (3)	-0.0020 (7)	0.0032 (6)	-0.0064 (2)
Ba3B	0.0262 (8)	0.0161 (3)	0.0110 (3)	-0.0020 (7)	0.0032 (6)	-0.0064 (2)
Y1	0.0064 (14)	0.0169 (15)	0.0089 (14)	0	0.0050 (9)	0
Y2	0.0062 (13)	0.0078 (12)	0.0022 (10)	0	-0.0011 (8)	0



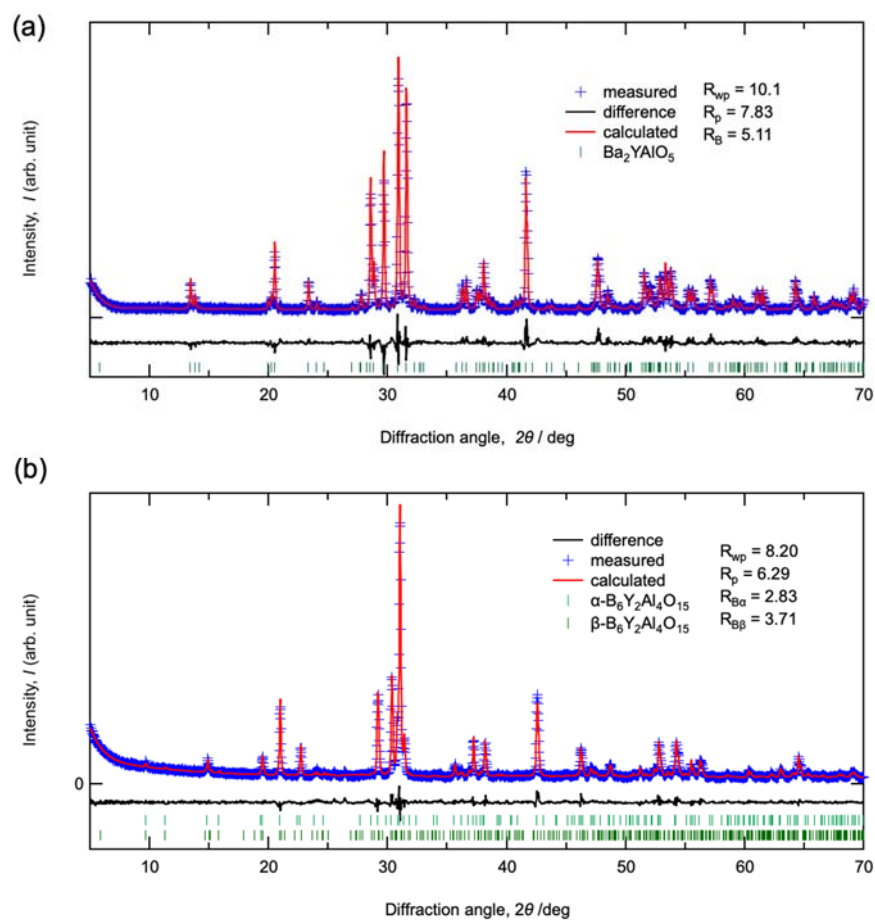
**Figure S1**

Crystal structure of  $\text{Ba}_2\text{YAlO}_5$  and structure of  $\text{Ba}_8$  hexahedral layers containing  $\text{YO}_6$  octahedra and  $\text{AlO}_3$  tetrahedra drawn parallel to (a) (11-1) and (b) (-10-1) planes. These planes are representative of three equivalent planes:  $\{11-1\} = (11-1), (1-1-1), (-1-11), (-111)$  and  $\{101\} = (101), (-10-1)$ .

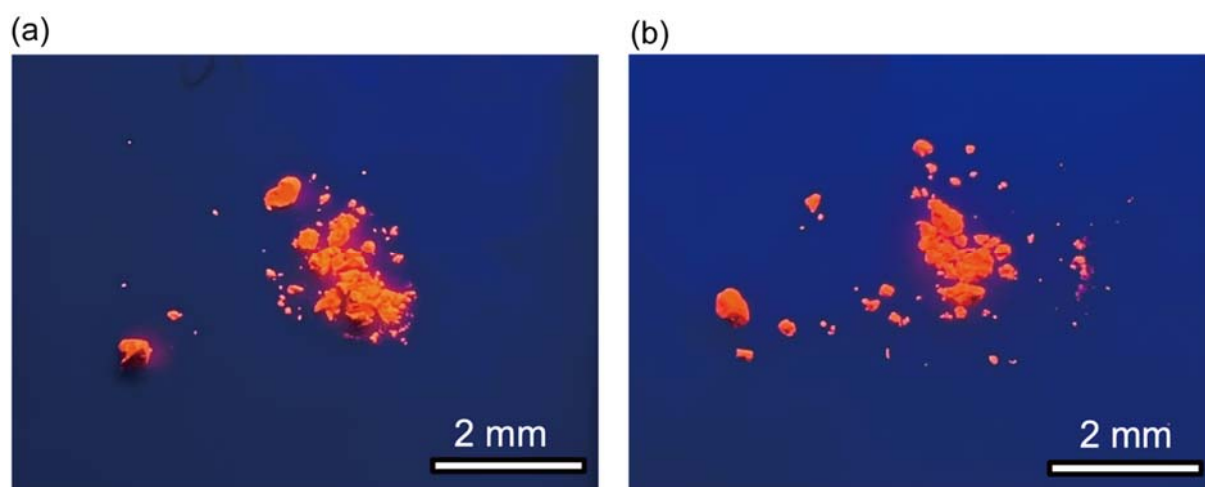
**Figure S2**

Crystal structure of  $\beta$ -Ba<sub>6</sub>Y<sub>2</sub>Al<sub>4</sub>O<sub>15</sub> and structure of Ba<sub>8</sub> hexahedral layers containing YO<sub>6</sub> octahedra and AlO<sub>3</sub> tetrahedra drawn parallel to (a) (0-13) and (b) (100) planes. These planes are representative of three equivalent planes:  $\{01\bar{3}\} = (013), (01\bar{3}), (0\bar{1}3), (0\bar{1}\bar{3})$  and  $\{100\} = (100), (-100)$ .



**Figure S4**

Powder X-ray diffraction patterns for (a)  $Ba_2Y_{0.85}Eu_{0.15}AlO_5$  and (b)  $Ba_6Y_{1.7}Eu_{0.3}Al_4O_{15}$ .



**Figure S5**

Optical micrographs showing orange-red luminescence of (a)  $\text{Ba}_2\text{Y}_{0.85}\text{Eu}_{0.15}\text{AlO}_5$  and (b)  $\alpha$ - and  $\beta$ - $\text{Ba}_6\text{Y}_{1.7}\text{Eu}_{0.3}\text{Al}_4\text{O}_{15}$  powders in response to irradiation at 250 nm.