Supporting Information for JMC

Crystal structure and blue-white-yellow color-tunable $Ca_4Si_2O_7F_2:Eu^{2+},Mn^{2+}$ phosphor through energy transfer for single-phase white-light near-ultraviolet LEDs

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Table S1 Atomic positions and lattice parameters for $(Ca_{0.89}Eu_{0.01}Mn_{0.1})_4Si_2O_7F_2$ phosphors

Atoms	*x*	*y*	*z*	Frac	Uiso*100
Ca(1)	0.1715(10)	0.1353(7)	0.4274(6)	0.89	4.09(2)
Ca(2)	0.6614(10)	0.1311(7)	0.4166(6)	0.89	4.38(2)
Ca(3)	0.4658(10)	0.4160(7)	0.3185(6)	0.89	3.65(2)
Ca(4)	0.9723(10)	0.4049(7)	0.3069(6)	0.89	3.54(2)
Eu(1)	0.1715(10)	0.1353(7)	0.4274(6)	0.01	4.09(2)
Eu(2)	0.6614(10)	0.1311(7)	0.4166(6)	0.01	4.38(2)
Eu(3)	0.4658(10)	0.4160(7)	0.3185(6)	0.01	3.65(2)
Eu(4)	0.9723(10)	0.4049(7)	0.3069(6)	0.01	3.54(2)
Mn(1)	0.1715(10)	0.1353(7)	0.4274(6)	0.10	4.09(2)
Mn(2)	0.6614(10)	0.1311(7)	0.4166(6)	0.10	4.38(2)
Mn(3)	0.4658(10)	0.4160(7)	0.3185(6)	0.10	3.65(2)
Mn(4)	0.9723(10)	0.4049(7)	0.3069(6)	0.10	3.54(2)
Si(1)	0.2737(13)	0.1845(10)	0.1352(8)	1.00	3.95(3)
Si(2)	0.8444(13)	0.1952(11)	0.1215(9)	1.00	3.53(3)
O(1)	0.0627(26)	0.2284(13)	0.1175(14)	1.00	4.10(5)
O(2)	0.2794(26)	0.0401(18)	0.1780(16)	1.00	2.30(5)
O(3)	0.7952(26)	0.0486(18)	0.1493(16)	1.00	3.50(6)
O(4)	0.2638(21)	0.2698(18)	0.2547(14)	1.00	2.70(5)
O(5)	0.7335(22)	0.2954(20)	0.2418(15)	1.00	3.90(5)
O(6)	0.4121(20)	0.2383(17)	0.9926(13)	1.00	2.30(5)
O(7)	0.8591(24)	0.2275(21)	0.9730(14)	1.00	5.80(6)
F(1)	0.5506(27)	0.4935(18)	0.1111(16)	1.00	3.20(4)
F(2)	0.0786(24)	0.5039(17)	0.0999(15)	1.00	3.00(5)

Table S2 Selected bond distances (Å) in $(Ca_{0.89}Eu_{0.01}Mn_{0.1})_4Si_2O_7F_2$ phosphors

Ca(1)/Eu(1)/Mn(1)−O(1)	2.43367(6) Å	Ca(2)/Eu(2)/Mn(2)−F(1)	2.40116(6)	Ca(4)/Eu(4)/Mn(4)−O(5)	2.43950(5)
Ca(1)/Eu(1)/Mn(1)−O(2)	2.76098(8)	Ca(2)/Eu(2)/Mn(2)−F(2)	2.33407(6)	Ca(4)/Eu(4)/Mn(4)−O(7)	2.22327(6)
Ca(1)/Eu(1)/Mn(1)−O(4)	2.27677(6)			Ca(4)/Eu(4)/Mn(4)−F(2)	2.37536(7)
Ca(1)/Eu(1)/Mn(1)−O(6)	2.53961(6)	Ca(3)/Eu(3)/Mn(3)−O(2)	2.33768(6) Å		
Ca(1)/Eu(1)/Mn(1)−O(7)	2.66753(7)	Ca(3)/Eu(3)/Mn(3)−O(3)	2.34480(6)	Si(1)−O(1)	1.73050(5) Å
Ca(1)/Eu(1)/Mn(1)−F(1)	2.49436(6)	Ca(3)/Eu(3)/Mn(3)−O(4)	2.42937(5)	Si(1)−O(2)	1.59836(5)
Ca(1)/Eu(1)/Mn(1)−F(2)	2.44023(6)	Ca(3)/Eu(3)/Mn(3)−O(5)	2.29453(6)	Si(1)−O(4)	1.56821(4)
Ca(1)/Eu(1)/Mn(1)−F(2)	2.30778(6)	Ca(3)/Eu(3)/Mn(3)−O(6)	2.43406(6)	Si(1)−O(6)	1.66004(5)
		Ca(3)/Eu(3)/Mn(3)−F(1)	2.29127(7)		
Ca(2)/Eu(2)/Mn(2)−O(3)	2.88883(9) Å			Si(2)−O(1)	1.67008(5) Å
Ca(2)/Eu(2)/Mn(2)−O(5)	2.50206(6)	Ca(4)/Eu(4)/Mn(4)−O(1)	2.69879(7) Å	Si(2)−O(3)	1.59677(5)
Ca(2)/Eu(2)/Mn(2)−O(6)	2.25437(6)	Ca(4)/Eu(4)/Mn(4)−O(2)	2.33661(6)	Si(2)−O(5)	1.67711(4)
Ca(2)/Eu(2)/Mn(2)−O(7)	2.33435(5)	Ca(4)/Eu(4)/Mn(4)−O(3)	2.48403(5)	Si(2)−O(7)	1.62614(5)
Ca(2)/Eu(2)/Mn(2)−F(1)	2.25499(5)	Ca(4)/Eu(4)/Mn(4)−O(4)	2.52145(6)	Si(1)−O(1)	1.73050(5) Å