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A Novel Garnet-based Cyan-emitting Phosphor $Ca_2LuHf_2(AlO_4)_3:Ce^{3+}$: Synthesis, Structure and Photoluminescence Properties

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Table S1.Detailed parameters for Rietveld refinement of CLHA crystal structure

Data collection	
Temperature (K)	296(2)
2θ range (°)	10 - 80
step interval (°)	0.02
Counting time per step (s)	1
Reflection number	104
Refined parameters	
Unit cell, background coefficients, zero shift, scale factor, profile coefficients, spherical harmonics preferred orientation.	
Background function	Shifted Chebyscev
Profile function	Pseudo Voiget
R-factors	
S (R_{wp}/ R_p)	1.180
R_F^2	0.080

Table S2. Atomic coordinates and isotropic displacement parameters for CLHA

Atom	Wyckoff	S.O.F	*x*	*y*	*z*	Uiso
Ca	24c	0.6667	1/8	0	0	0.0384
Lu	24c	0.3333	1/8	0	0	0.0384
Hf	16a	1	0	0	0	0.0342(19)
Al	24d	1	1/8	0	3/4	0.012(7)
O	96h	1	-0.0252(17)	0.055(4)	0.1460(25)	0.119(26)

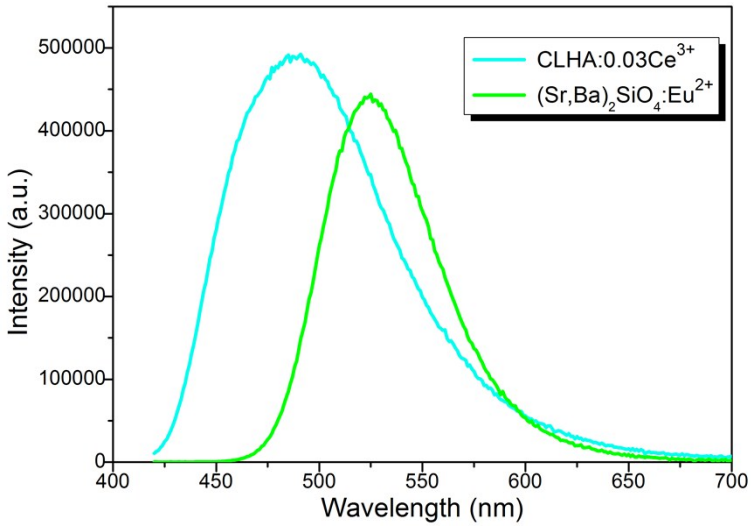

Figure S1. The emission spectra of CLHA:0.03Ce^{3+} and commercial $(Sr,Ba)_2SiO_4:Eu^{2+}$:Eu^{2+} phosphor.

Table S3. Luminescence properties of CLHA:Ce^{3+} comparing with other analogues

Phosphor	Emission peak(nm)	QE (%)	Intensity at 150°C(%)	Ref
$Ca_2GdZr_2(AlO_4)_3:Ce^{3+}$	500	40.26	~33	23
$Ca_2LaZr_2Ga_3O_{12}:Ce^{3+}$	512	35.2	~30	14
$Ca_3Zr_2SiGa_2O_{12}:Ce^{3+}$	478	42.7	~43	24
CLHA:Ce^{3+}	484	50.3	87	this work