Supplementary Information (SI) for Journal of Materials Chemistry C.
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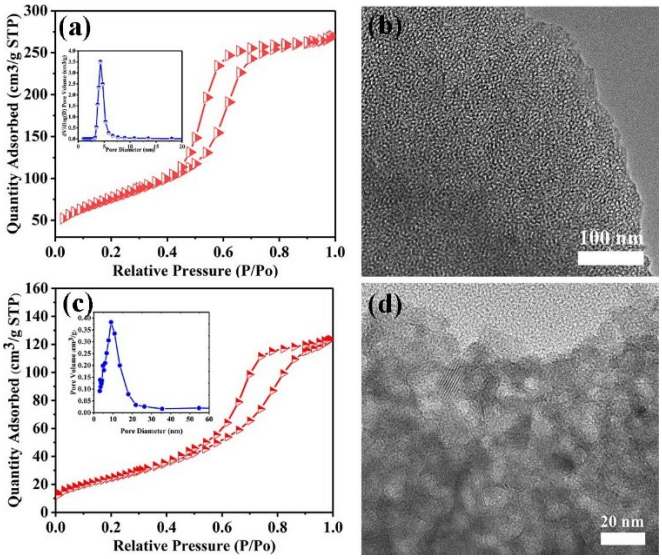

Fig. S1 (a, c) N_2 isotherm adsorption-desorption curves and pore size distributions (insets) and (b,d) TEM images of the synthesized Al_2O_3 powders and Y_2O_3 powders, respectively.

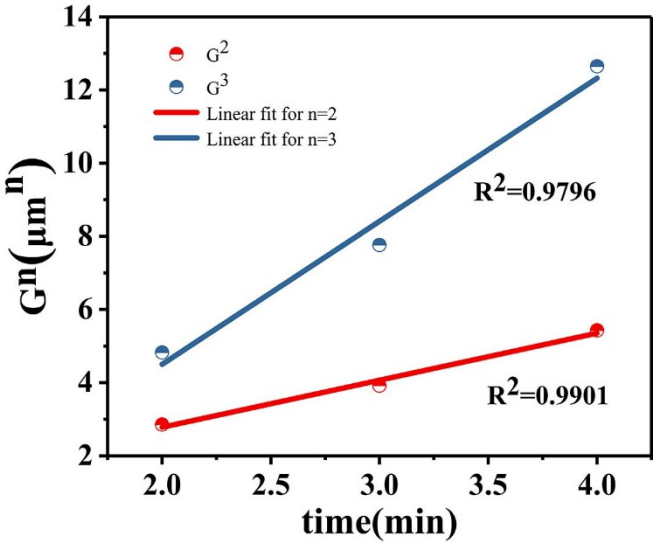

Fig. S2 Fitting curves of G^n and holding time t of YAG ceramics at 1350℃

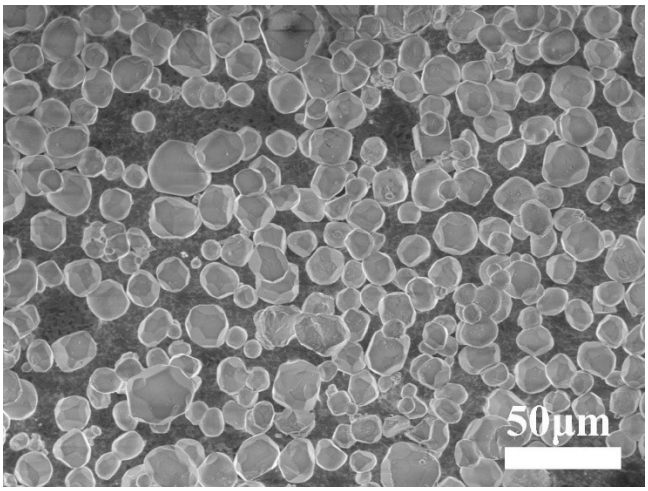

Fig. S3 SEM image of the commercial YAG:Ce phosphor.

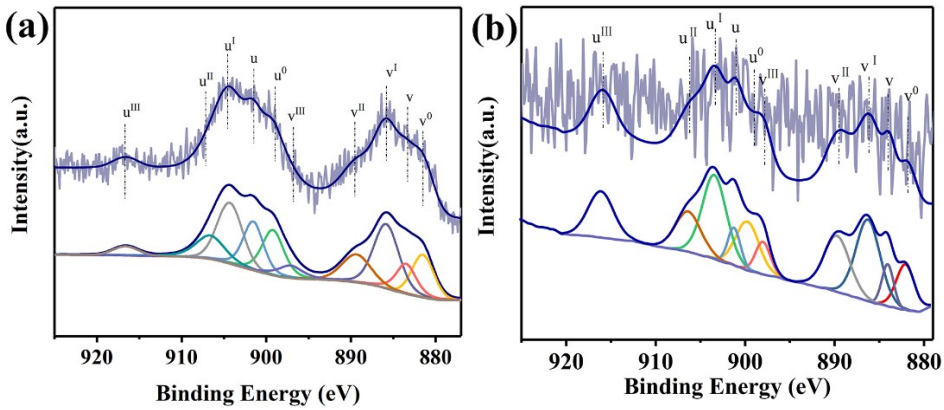

Fig. S4 X-ray photoelectron spectroscopy (XPS) spectra of Ce $3d_{3/2,5/2}$ in (a) YAG:Ce phosphors and (b) YAG-YAG:Ce CPC, and corresponding fitting curves.

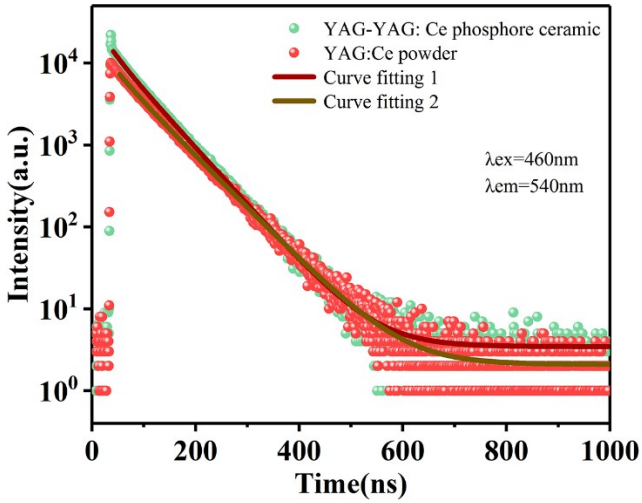

Fig. S5 The fluorescence decay curves of YAG:Ce phosphors, YAG-YAG:Ce CPC and corresponding fitting curves. Fitting curve 1 is for YAG-YAG:Ce CPC, and fitting curve 2 is for YAG:Ce phosphors. The excitation and emission wavelength are 460 nm and 540 nm, respectively.

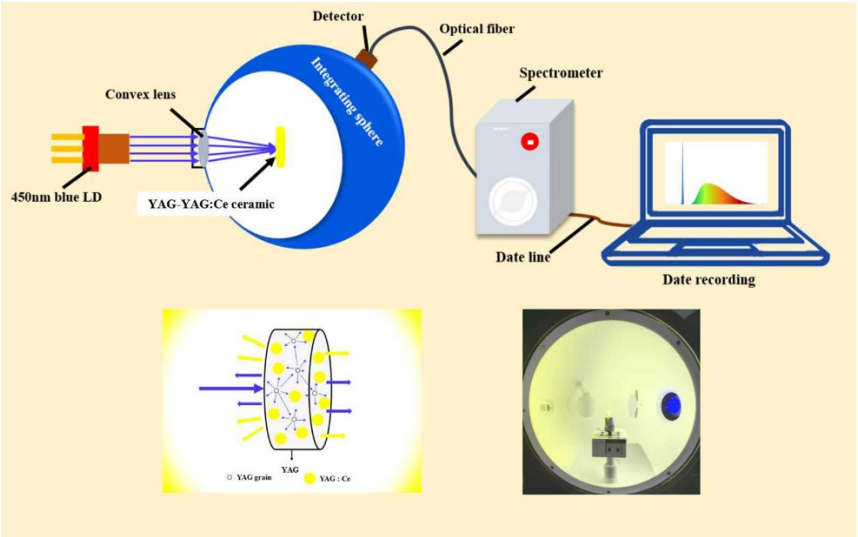

Fig. S6 The measurement device scheme and physical map after being lighted up in remote excitation for laser-driven illumination.

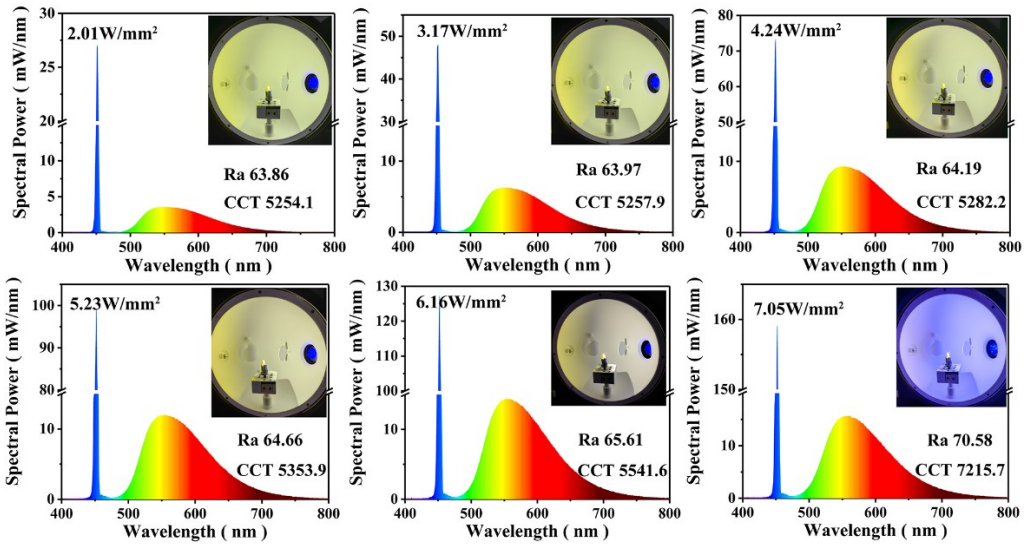

Fig. S7 Luminescence spectra and corresponding color rendering indexes (CRI), correlated color temperatures (CCT) and physical images of YAG-YAG:Ce CPC with a 6 wt% phosphor concentration under 450 nm blue lasers with different power densities.

Table S1 The core excitation binding energy (eV) of Ce 3d in YAG:Ce phosphors and YAG-20 wt% YAG:Ce CPC, and the corresponding relative contents collected from Ce^{3+} and Ce^{4+}.

	Ce: YAG	Peak/eV	Area/a.u.	Relative perc/%	CPC	Peak/eV	Area/a.u.	Relative perc/%
Ce^{4+} 3d	$3d_{3/2}$	901.55	1930.21	43.51%	$3d_{3/2}$	901.63	182.96	45.40%
	$3d_{5/2}$	883.49	1252.54		$3d_{5/2}$	883.43	167.61	
	$3d_{3/2}$	906.61	1386.52		$3d_{3/2}$	905.89	295.41	
	$3d_{5/2}$	889.36	1535.88		$3d_{5/2}$	889.19	625.3	
	$3d_{3/2}$	916.57	409.54		$3d_{3/2}$	916.13	467.58	
	$3d_{5/2}$	897.16	696.69		$3d_{5/2}$	897.38	198.45	
Ce^{3+} 3d	$3d_{3/2}$	899.22	1965.08	56.49%	$3d_{3/2}$	900.06	605.46	54.60%
	$3d_{5/2}$	881.51	1657.74		$3d_{5/2}$	881.78	331.68	
	$3d_{3/2}$	904.32	2708.86		$3d_{3/2}$	903.53	702.48	
	$3d_{5/2}$	885.85	3031.41		$3d_{5/2}$	885.8	689.97	

Table S2. Typical research progress of Ce:YAG phosphor ceramics.

Composition	Saturation Power Density (W/mm^2)	LF (lm)	LE (lm/W)	Reference
YAG:Ce phosphor in silica glass (PiSG)	3.46	—	—	*1*
Single-phase YAG:Ce transparent ceramic	—	—	170	*2*
Al_2O_3-YAG:Ce CPCs	—	1169	166	*3*
	47.6	651	144	*4*

Al_2O_3-YAG:Ce CPCs@aluminum	20	4294	215	*5*
$BaAl_2O_4$-YAG:Ce CPCs	—	479	37	*6*
MgO-YAG:Ce CPCs	32.2	3979	292	*7*
MgF_2-MgO-YAG:Ce CPCs	34.6	2834	198.9	*8*
AlN-YAG:Ce CPCs	—	639	266	*9*
YAG-YAG:Ce CPCs	9.60	—	142	*10*
Y_2O_3-YAG:Ce CPCs	6.14	805	178.4	*11*
YAG-YAG:Ce CPCs	**6.68**	**844**	**202.1**	***This work***

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