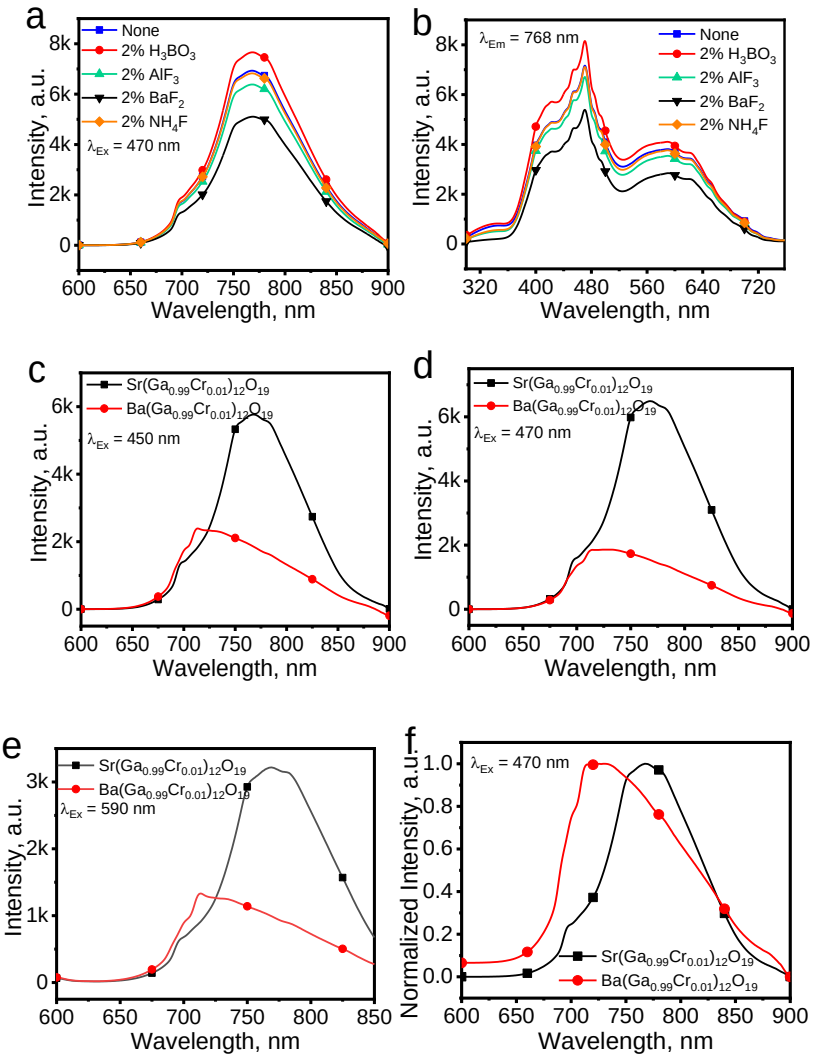
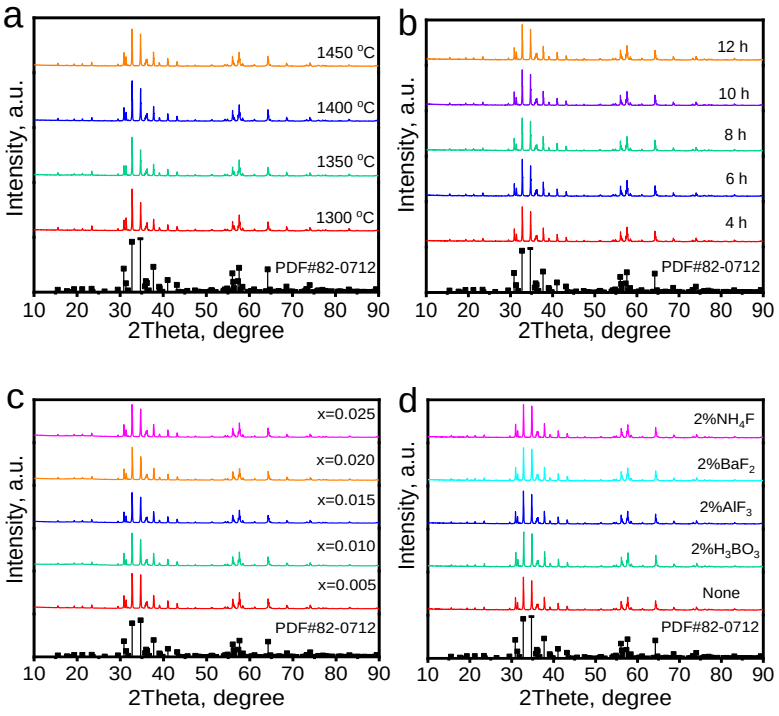
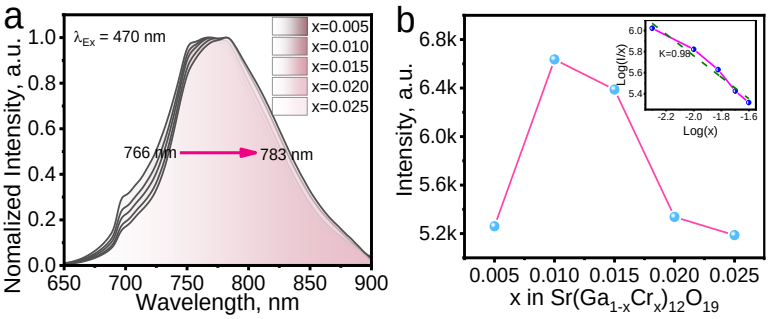
Supplementary Information



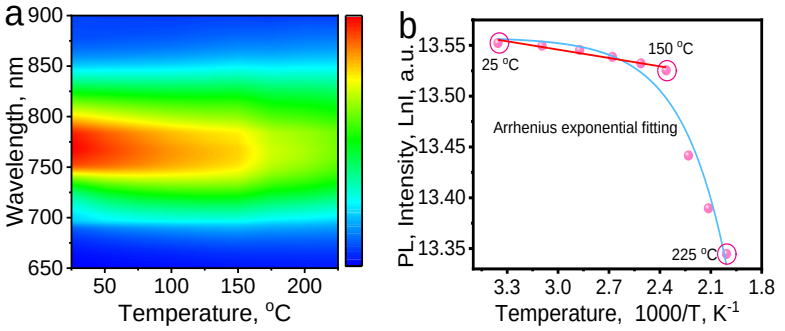
Supplementary Fig 1 The effect of fluxes and doped-Ba on $SrGa_{12}O_{19}:Cr^{3+}$. (a) emission and (b) excitation spectra of the $Sr(Ga_{0.99}Cr_{0.01})_{12}O_{19}$ phosphor synthesized at 1400 °C for 8 h with different fluxes; the emission spectra of $Sr(Ga_{0.99}Cr_{0.01})_{12}O_{19}$ and $Ba(Ga_{0.99}Cr_{0.01})_{12}O_{19}$ phosphors synthesized at 1400 °C for 8 h by exciting with 450 nm (c), 470 nm (d), and 590 nm (e), respectively; (f) the normalized emission spectra as corresponding to (d).



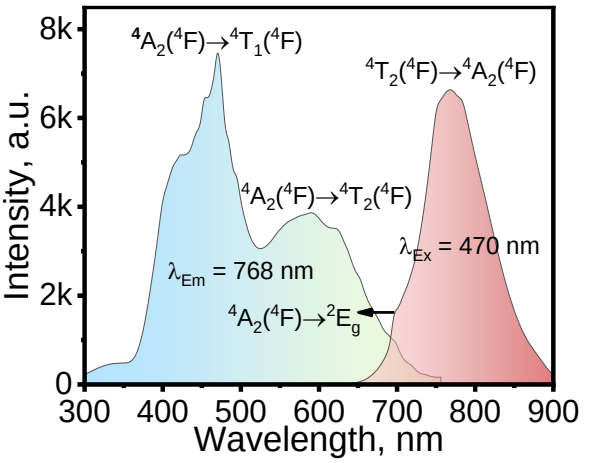
Supplementary Fig 2 XRD patterns of $Sr(Ga_{1-x}Cr_x)_{12}O_{19}$ phosphors synthesized at variant conditions. (a) synthesized at 1300, 1350, 1400, and 1450 °C for 4 h with x = 0.01; (b) synthesized at 1400 °C for 4, 6, 8, 10, and 12 h with x = 0.01; (c) synthesized at 1400 °C for 8 h with x = 0.005, 0.010, 0.015, 0. 020, and 0.025; (d) synthesized at 1400 °C for 8 h with x = 0.01 and assisted with variant fluxes.



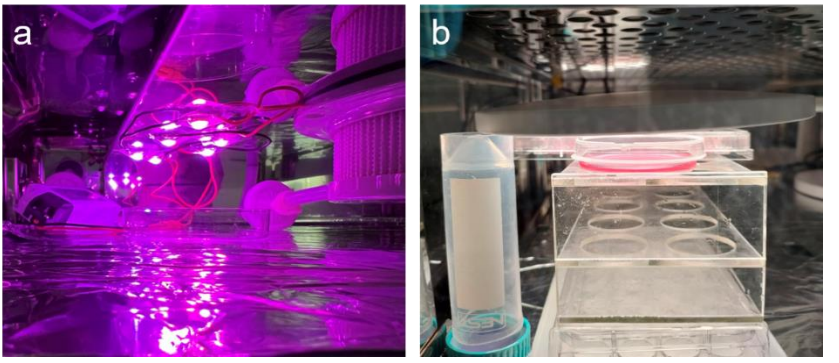
Supplementary Fig 3 The effect of Cr^{3+} concentration on the luminescence of $Sr(Ga_{1-x}Cr_x)_{12}O_{19}$ phosphors. (a) The normalized emission spectra of the $Sr(Ga_{1-x}Cr_x)_{12}O_{19}$ (x=0.005, 0.010, 0.015, 0.020, and 0.025) phosphors, synthesized at 1400 °C for 8 h by adding 1% H_3BO_3 +1% AlF_3 as flux, under the excitation of 470 nm; and (b) the integrated luminescence intensity of the $Sr(Ga_{1-x}Cr_x)_{12}O_{19}$ (x=0.005, 0.010, 0.015, 0.020 and 0.025) phosphors as function of Cr^{3+} concentration, where the inset presents the relationship of Log(I/x) and Log(x) to shown the concentration quenching mechanism of luminescence.



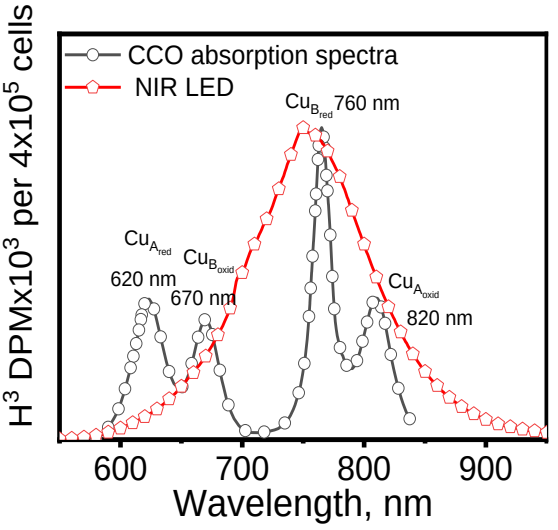
Supplementary Fig 4 The activation energy of thermal quenching luminescence of $Sr(Ga_{0.99}Cr_{0.01})_{12}O_{19}$ phosphor. (a) The luminescence spectra of the $Sr(Ga_{0.99}Cr_{0.01})_{12}O_{19}$, synthesized at 1400 °C for 8 h by adding 1% H_3BO_3 +1% AlF_3 as flux, excited with 470 nm at different temperatures; (b) the activation energy fitted using the Arrhenius equation based on the integrated luminescence intensity at different temperatures.



Supplementary Fig 5 The normalized emission and excitation spectra of the $Sr(Ga_{0.99}Cr_{0.01})_{12}O_{19}$, synthesized at 1400 °C for 8 h by adding 1% H_3BO_3 + 1% AlF_3 as flux, plotted together to show the Stokes shift, by which revealing the mechanism of high efficiency of luminescence.



Supplementary Fig 6 Activity assay and immunofluorescence detection plots of BV-2 microglia under different light environments. (a) Irradiation of BV2 microglia using the NIR LEDs array. (b) Control group - BV2 microglia irradiated with white LEDs.



Supplementary Fig 7 Plot of the luminescence spectrum of the LED device encapsulated with $Sr(Ga_{0.99}Cr_{0.01})_{12}O_{19}$ near-infrared phosphor against the absorption spectrum of Cytochrome c oxidase.

Supplementary Table 1 Results of structural refinements on the site occupation of Cr^{3+} in the $SrGa_{12}O_{19}$ host.

Site	x	y	z	Occupancy	Wyckoff Position	
Sr1	0.6667	0.3333	0.2500	1.0000	2d	
Ga1	0.0000	0.0000	0.0000	0.9232	2a	Space group *P* 63/mmc (194)
Ga2	0.0000	0.0000	0.2572(4)	0.5000	4e	
Ga3	0.3333	0.6667	0.0272(7)	1.0000	4f	
Ga4	0.3333	0.6667	0.1899(8)	0.9223	4f	Symmetry Hexagonal
Ga5	0.1683(11)	0.3367(23)	0.8907(4)	0.9163	12k	
O1	0.0000	0.0000	0.1495(32)	1.0000	4e	a=5.7934(0) Å
O2	0.6667	0.3333	0.0553(4)	1.0000	4f	b=5.7934(0) Å
O3	0.1818(7)	0.3636(14)	0.2500	1.0000	6h	c=22.8294(2) Å
O4	0.1555(5)	0.3110(9)	0.0525(17)	1.0000	12k	v=663.57(1) $Å^3$
O5	0.5045(6)	0.0090(13)	0.1500(18)	1.0000	12k	
Cr1	0.0000	0.0000	0.0000	0.0768	2a	
Cr2	0.0000	0.0000	0.2572	0.0000	2a	
Cr3	0.3333	0.6667	0.0272	0.0000	2a	
Cr4	0.3333	0.6667	0.1899	0.0777	4f	
Cr5	0.1683	0.3367	0.8907	0.0837	12k	