

Supporting Information

Efficient Cr³⁺-activated NaInP₂O₇ phosphor for broadband near-infrared LED applications

Qi Wang,^{a,b,c} Shangwei Wang^{a,c} Tao Tan,^a Jiutian Wang,^a Ran Pang,^{*a} Da Li,^a

Chengyu Li^{*a,c} and Hongjie Zhang^a

^a State key Laboratory of Rare Earth Resource Utilization, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, Changchun 130022, P. R. China

^b Faculty of Materials Metallurgy and Chemistry, Jiangxi University of Science and Technology, Ganzhou, Jiangxi 341000, P.R. China

^c Ganjiang Innovation Academy, Chinese Academy of Sciences, Ganzhou 341000, P. R. China

* Corresponding author: Tel: +86-0431-85262258

E-mail address: cyli@ciac.ac.cn and pangran@ciac.ac.cn

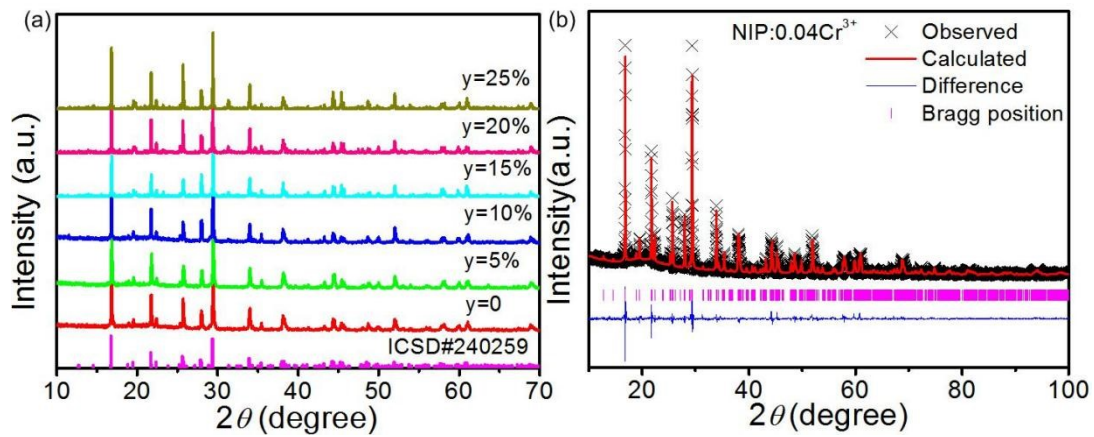


Fig. S1 (a) XRD patterns of NIP:0.04Cr³⁺+yLi₂CO₃ (y = 0-25%) and the NIP ICSD standard pattern. (b) Rietveld refinement of NIP:0.04Cr³⁺ sample.

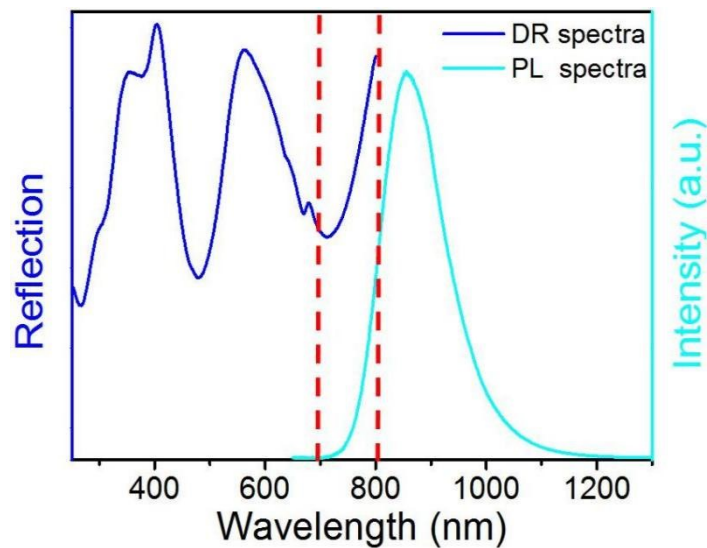


Fig. S2 DR and PL spectra of NIP:0.04Cr³⁺.

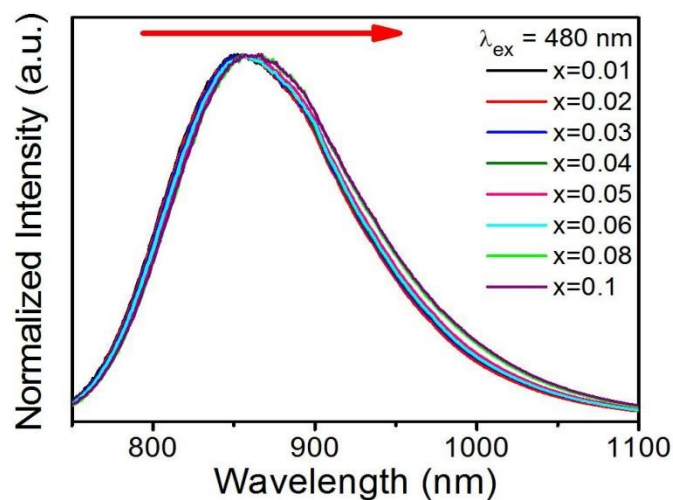


Fig. S3 Normalized PL spectra of NIP:xCr³⁺ (x = 0.01-0.1) samples phosphors under 480 nm excitation.

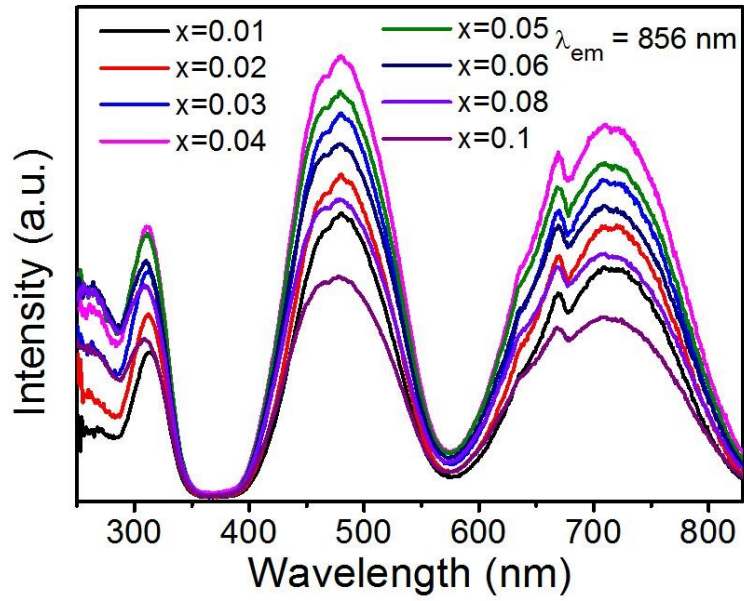


Fig. S4 PLE ($\lambda_{em} = 856 \text{ nm}$) spectra of the NIP: $x\text{Cr}^{3+}$ ($x = 0.01-0.1$) samples measured at room temperature.

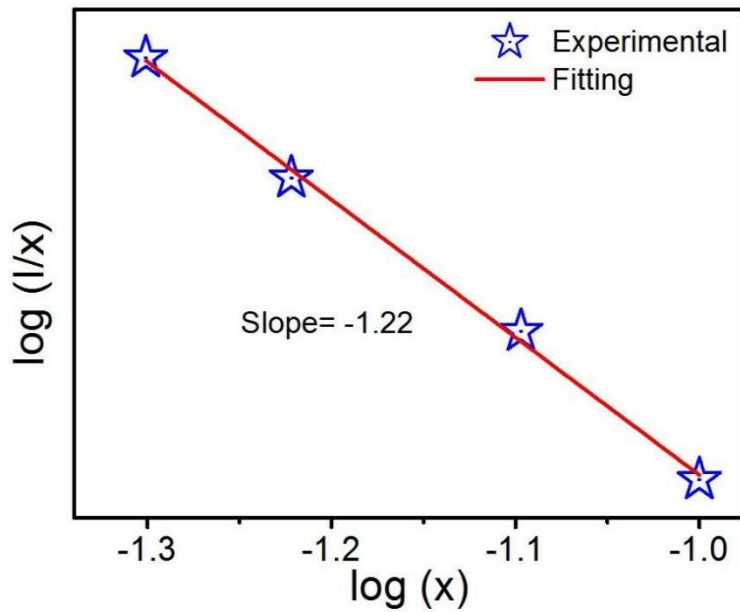


Fig. S5 The dependence of $\log(I/x)$ on $\log(x)$ for NIP: $x\text{Cr}^{3+}$ ($x = 0.05, 0.06, 0.08$ and 0.1) samples.

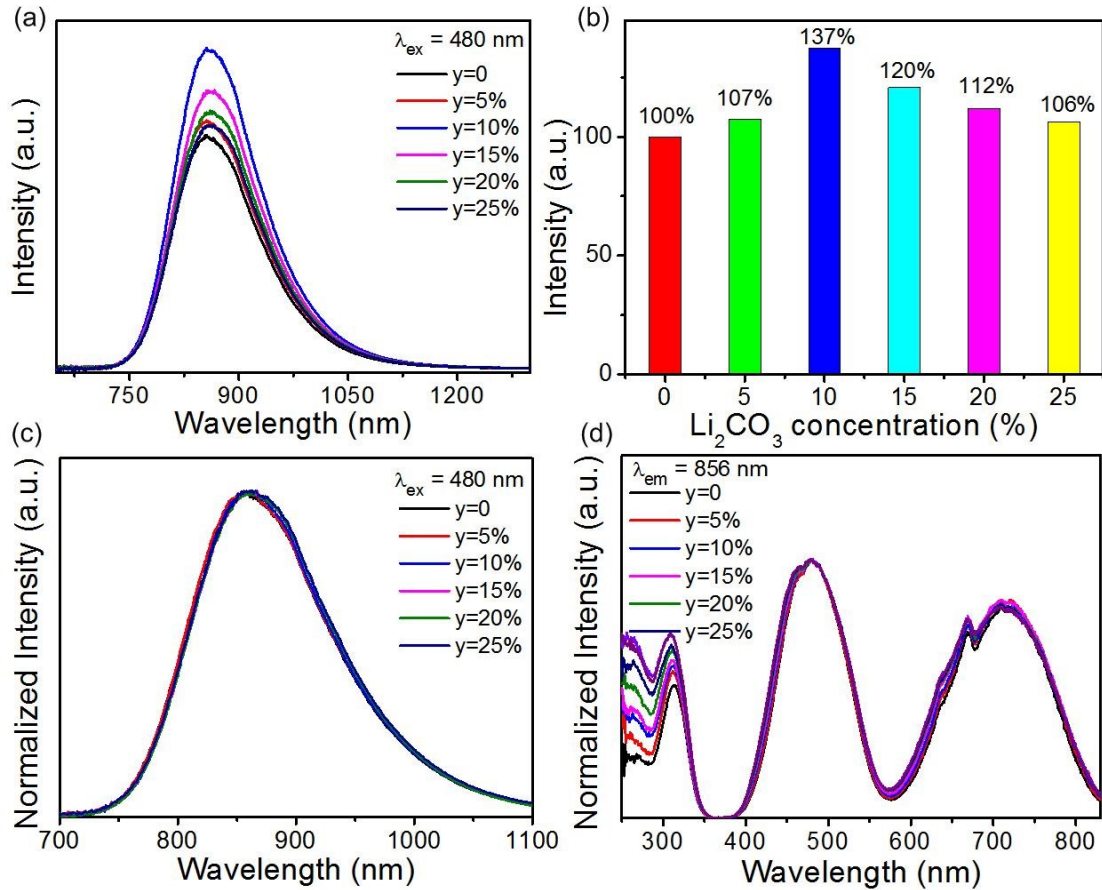


Fig. S6 (a) and (b) The PL spectra and integral intensity ratio of the emission of NIP:0.04Cr³⁺+yLi₂CO₃ (y = 0-25%) phosphors, respectively. (c) Normalized PL spectra of NIP:0.04Cr³⁺+yLi₂CO₃ (y = 0-25%) phosphors under 480 nm excitation. (d) Normalized PLE ($\lambda_{em} = 856$ nm) spectra of NIP:0.04Cr³⁺+yLi₂CO₃ (y = 0-25%) phosphors.

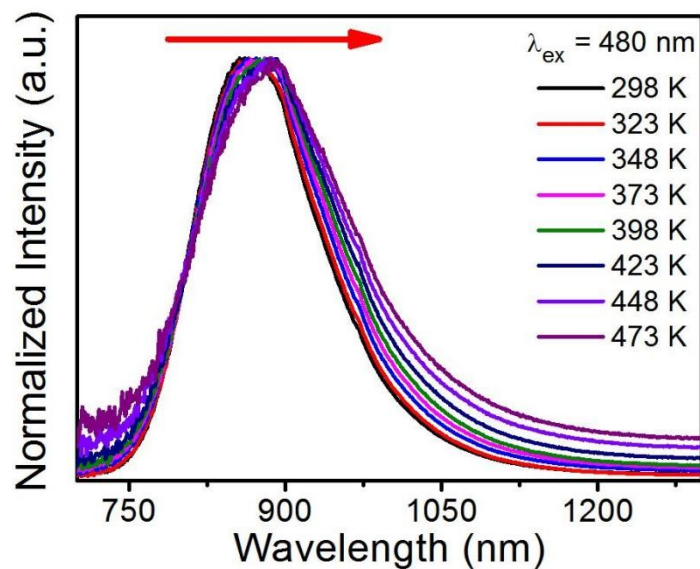


Fig. S7 Normalized PL spectra of NIP:0.04Cr³⁺ phosphor under 480 nm excitation at different temperature.

Table S1 Structural parameters of NIP determined by Rietveld refinement of the corresponding XRD pattern.

Atom	<i>x</i>	<i>y</i>	<i>z</i>	Occ	U _{iso}
Na	0.28287	0.02546	0.78067	1.0	0.00672
In	0.25413	0.00531	0.25012	1.0	0.01171
P1	0.07129	0.24805	0.95617	1.0	0.02351
P2	0.33253	0.722	0.05464	1.0	0.01195
O1	0.05374	0.08751	0.87003	1.0	0.00636
O2	0.13078	0.64122	0.07593	1.0	0.00189
O3	0.17173	0.24176	0.12999	1.0	0.00843
O4	0.20069	0.13967	0.44798	1.0	0.05609
O5	0.29304	0.72092	0.89136	1.0	0.00354
O6	0.40363	0.59119	0.60111	1.0	0.03244
O7	0.45396	0.59961	0.12881	1.0	0.01586

Table S2 Structural parameters of NIP:0.04Cr³⁺ determined by Rietveld refinement of the corresponding XRD pattern.

Atom	<i>x</i>	<i>y</i>	<i>z</i>	Occ	U _{iso}
Na	0.28627	0.01972	0.7913	1.0	0.02521
In	0.25651	0.00412	0.24934	0.95986	0.01227
Cr	0.25651	0.00412	0.24934	0.04014	0.01227
P1	0.07885	0.2489	0.96596	1.0	0.01329
P2	0.33567	0.72341	0.04891	1.0	0.0139
O1	0.05565	0.0771	0.84422	1.0	0.0192
O2	0.12449	0.65589	0.06794	1.0	0.00163
O3	0.1787	0.22918	0.11906	1.0	0.00741
O4	0.18044	0.14651	0.40977	1.0	0.00132
O5	0.28694	0.7085	0.89938	1.0	0.01094
O6	0.38774	0.59976	0.59611	1.0	0.01291
O7	0.46472	0.5919	0.13516	1.0	0.01442