Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.


# Supporting information

# Enhancement of photoluminescence modulation ratio in highly transparent KNN-based ceramics for optical information storage

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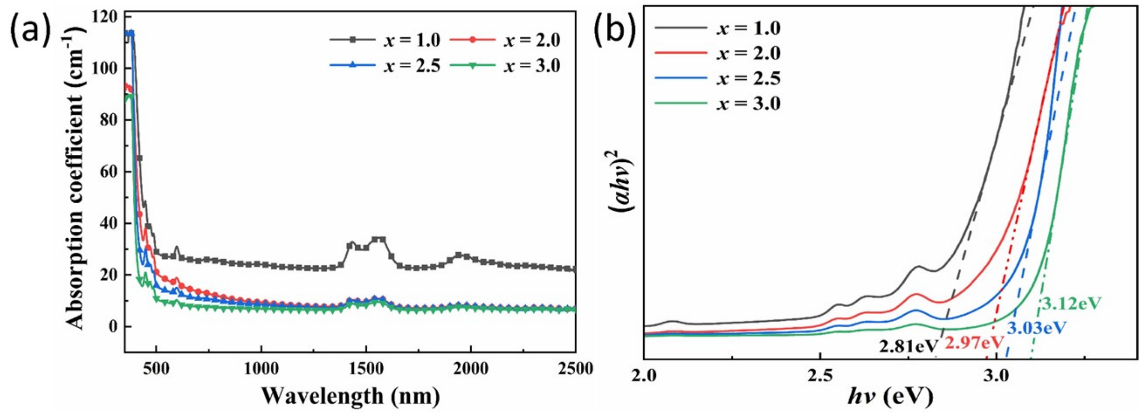


**Fig. S1** (a) Absorption coefficient spectra of KNN-*x*Pr ceramics ($t$ = 0.045 cm). (b) The plots of $(\alpha h\nu)^2$ vs. $h\nu$, and the energy band gap ($E_g$).

The relationship between $E_g$ and photon frequency follows the Tauc equation:[1, 2]

$$(\alpha h\nu)^2 = A(h\nu - E_g)$$

where $h$ is the Planck's constant ($4.1357\times10^{-15}$ eV), A is a constant, $\nu$ is the photon frequency, and $\alpha$ is the absorption coefficient. $\nu$ and $\alpha$ can be calculated according to the following equations:

$$\nu = \frac{c}{\lambda}$$

$$\alpha = \frac{1}{t}\ln(\frac{1}{T})$$

where $c$, $t$, $\lambda$, and $T$ correspond to the speed of light ($3.0\times10^8$ m/s), sample thickness, wavelength, and transmittance, respectively. When plotting $(\alpha h\nu)^2$ versus $h\nu$ and extending the linear part of the curve to $(\alpha h\nu)^2 = 0$, the intersection point on the horizontal axis is $E_g$.

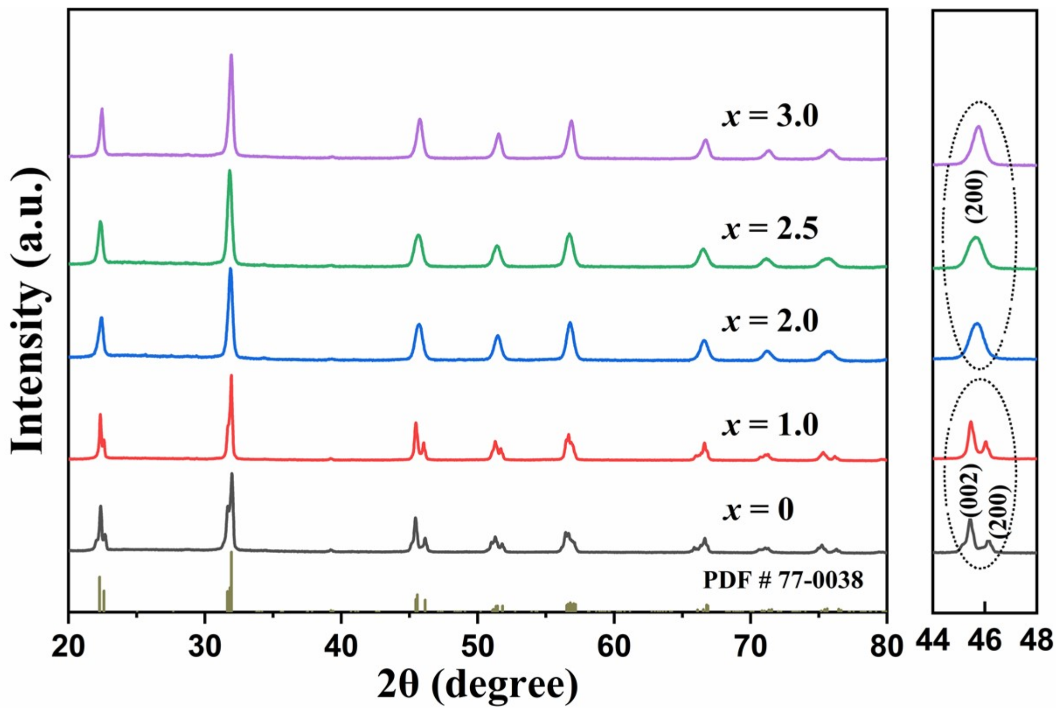


**Fig. S2** (a) XRD patterns of the KNN-*x*Pr (*x* = 0, 1.0, 2.0, 2.5 and 3.0) ceramics. (b) Magnification of peaks at 2θ ~ 44–47°.

**Table S1.** Average density and relative density of KNN-*x*Pr ceramics

| Sample | Density (g/cm$^3$) | | | | | Average density (g/cm$^3$) | Theoretical density (g/cm$^3$) | Relative densities (%) |
|---|---|---|---|---|---|---|---|---|
| | No. 1 | No. 2 | No. 3 | No. 4 | No. 5 | | | |
| *x* = 1.0 | 4.49 | 4.52 | 4.35 | 4.56 | 4.47 | 4.46 | 4.52 | 98.7 |
| *x* = 2.0 | 4.51 | 4.49 | 4.52 | 4.52 | 4.54 | 4.52 | 4.55 | 99.3 |
| *x* = 2.5 | 4.53 | 4.48 | 4.52 | 4.58 | 4.53 | 4.53 | 4.56 | 99.3 |
| *x* = 3.0 | 4.61 | 4.46 | 4.55 | 4.57 | 4.54 | 4.55 | 4.57 | 99.6 |

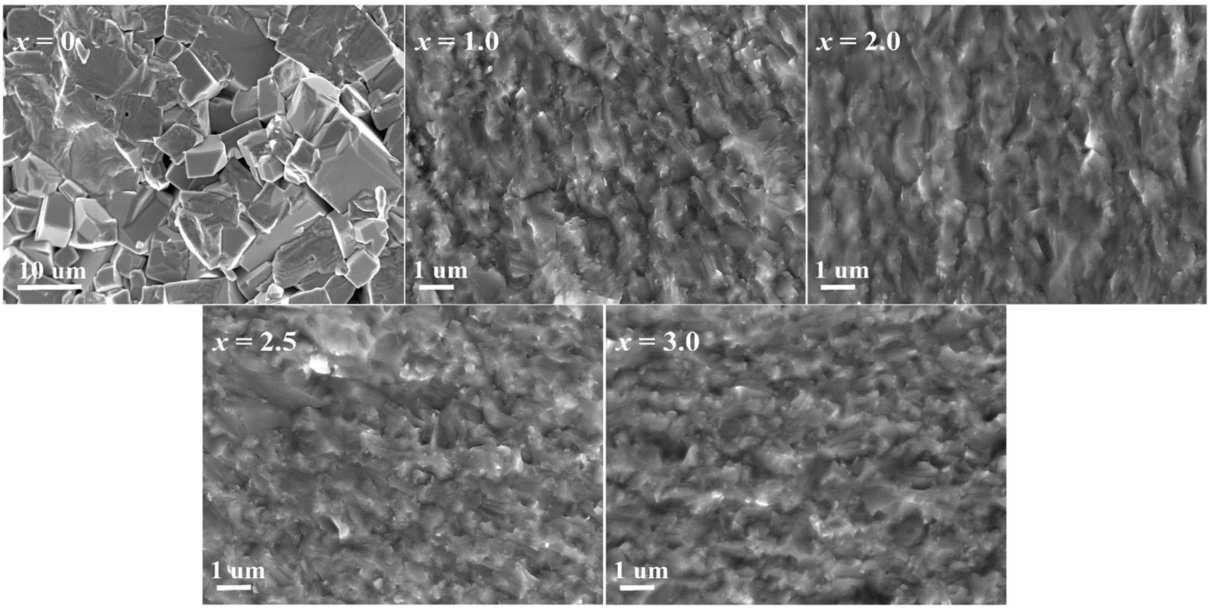


**Fig. S3** SEM images of fractured surfaces for the KNN-*x*Pr ceramics.

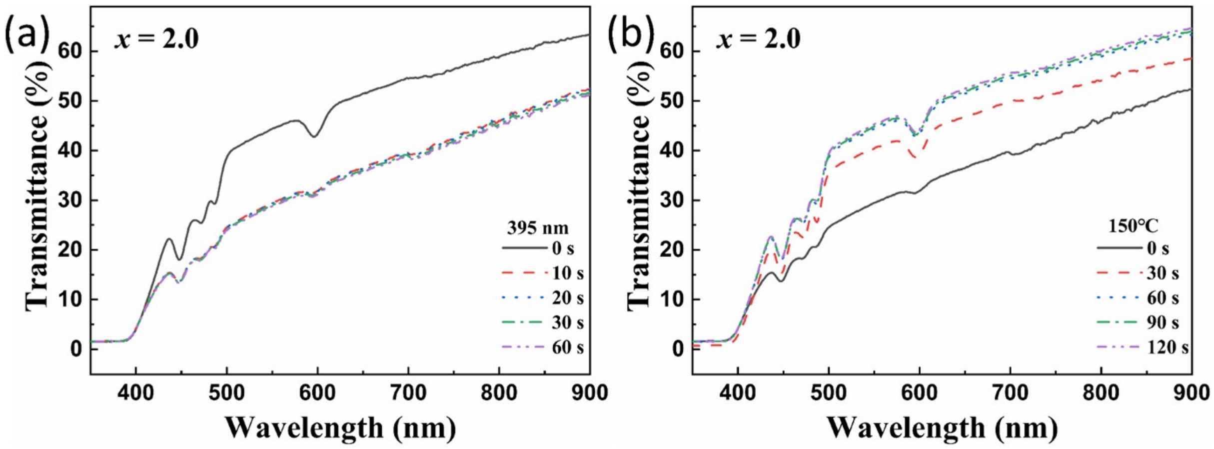


**Fig. S4** The dependence of transmittance on heating and illumination time of KNN-2Pr ceramics. (a) Transmittance after 395 nm illumination for different illumination times (0, 10, 20, 30 and 60 s), (b) Transmittance after 150$^{o}$C heating for different heating times (0, 30, 60, 90 and 120 s) (illuminated by 395 nm for 1 min).

As shown in Fig. S4, when the irradiation time is more than 10 s and the heating time is more than 60 s, the change of transmittance becoming not very large. In order to ensure sufficient time, we chose the illumination time of 30 s and a heating time of 60 s.

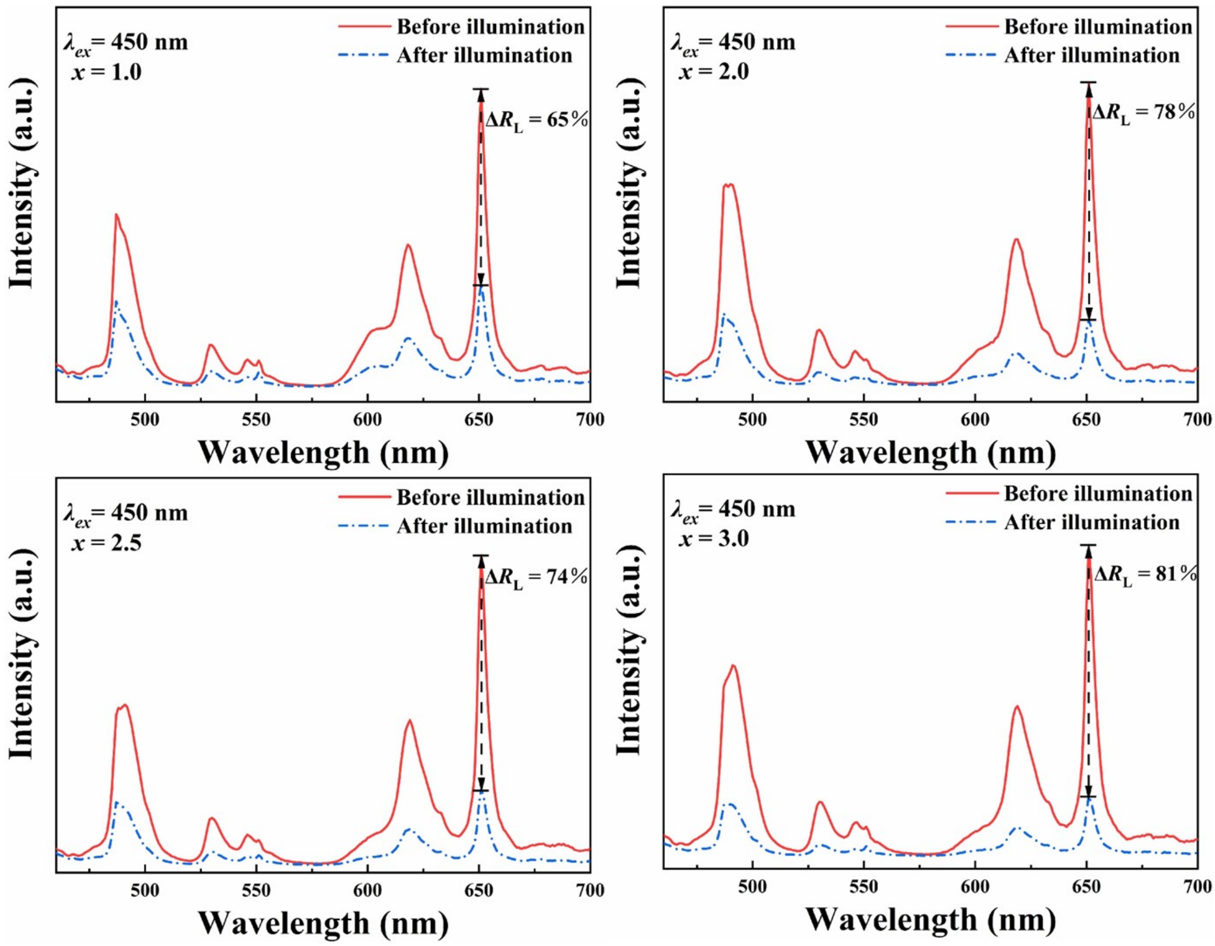


**Fig. S5** PL spectra under 450 nm excitation in KNN-*x*Pr ceramics before and after 395 nm light illumination for 30 s.

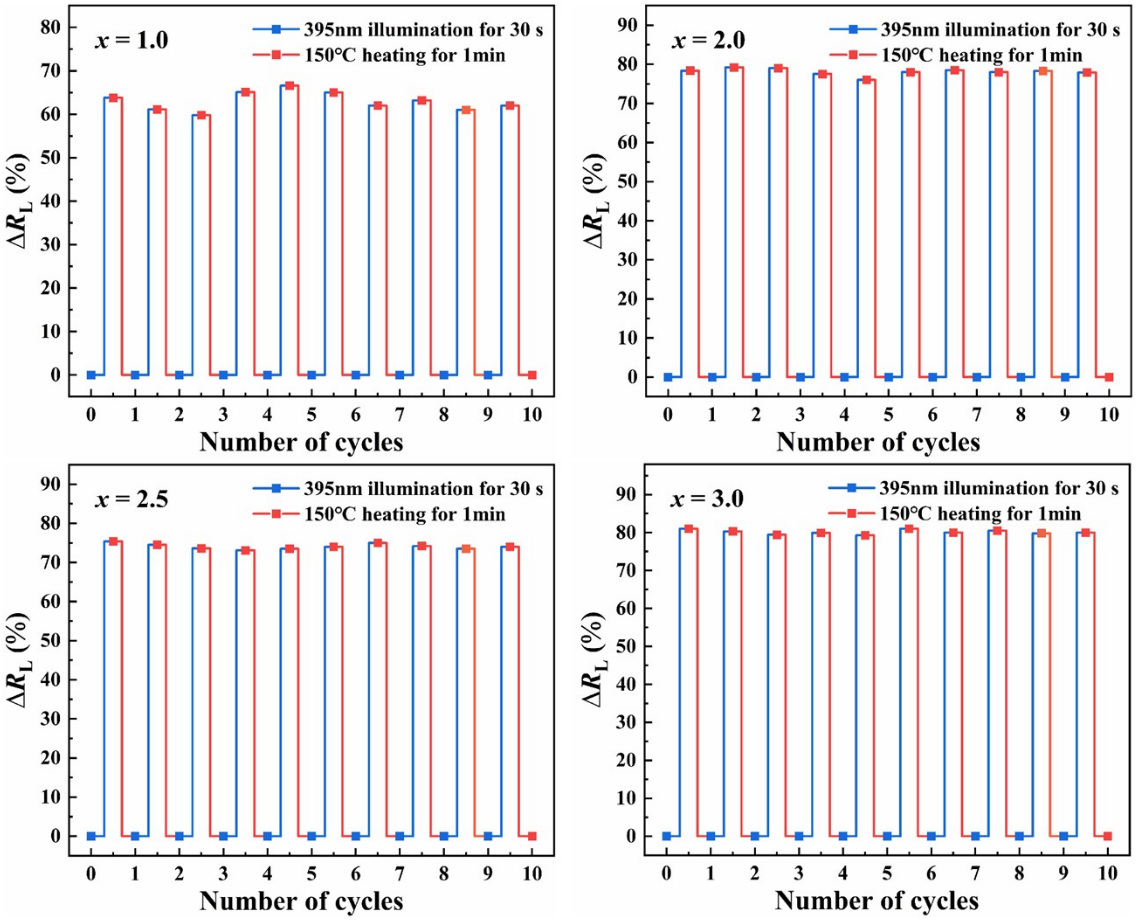


**Fig. S6** Changes of $\Delta R_L$ in KNN-*x*Pr ceramics when implementing 395 nm illumination (30 s) and thermal stimulus (150$^o$C for 1 min) alternately for 10 cycles.

# References


1 Y. Li, Y. Tang, F. Wang, X. Zhao, J. Chen, Z. Zeng, L. Yang and H. Luo, *Appl. Phys. A*, 2018, **124**, 1-5.

2 J. Lin, J. Xu, C. Liu, Y. Lin, X. Wu, C. Lin, X. Zheng and C. Chen, *J. Alloys Compd.*, 2019, **784**, 60-67.