Electronic Supplementary Material (ESI) for Dalton Transactions.

Developing near-infrared long-lasting phosphorescence of Yb^{3+} through medium: energy-transfer insight in novel material $Zn_{1.98}Li_{0.02}P_2O_7:Yb^{3+}$

Huimin Li,[a,b] Ran Pang,[a] Su Zhang,[a,*] Lingling Lv,[a] Jing Feng,[a] Lihong Jiang,[a] Da Li,[a] Chengyu Li[a,*] and Hongjie Zhang[a]

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

[b] University of Chinese Academy of Sciences, Beijing 100049, P. R. China.

* Corresponding author: Tel.:+86-0431-85262208

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

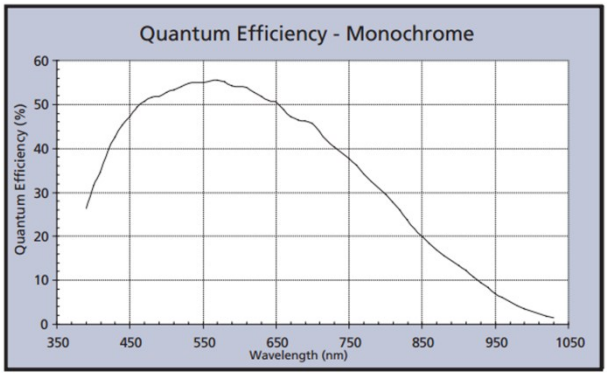

Fig. S1. Quantum Efficiency—Monochrome.

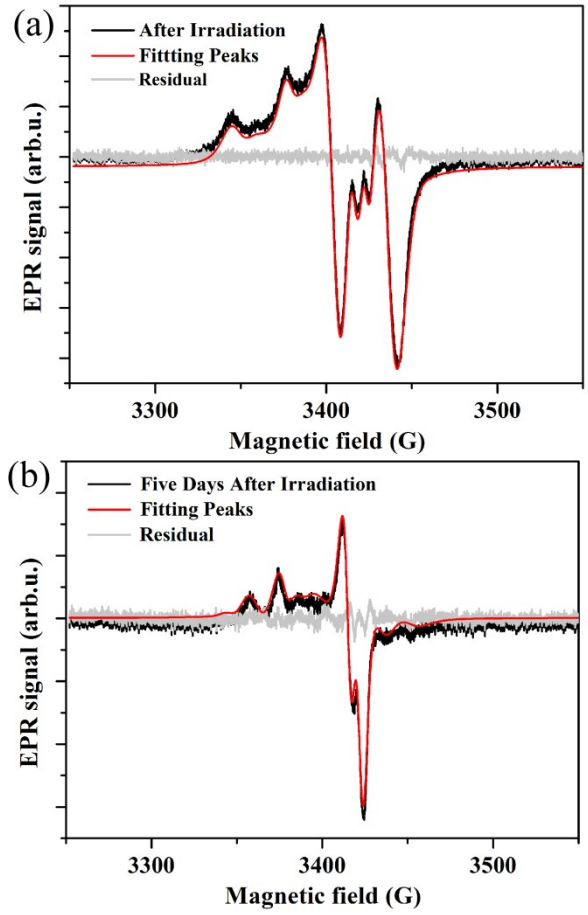

Fig. S2. The $Zn_{1.976}Yb_{0.004}Li_{0.02}P_2O_7$ EPR signals with the fitted peaks in different treating processes of after irradiation (a) and five days after irradiation (b).

Table S1. The EPR signal fitting parameters of in Figure S1 (a) and (b).

Peaks	g-Factor	Line-Width (a)	Area (a)	Line-Width (b)	Area (b)
Peak1	1.988	8.61	108.7	15.84	109.6
Peak2	1.998	12.9	1240	10.22	116.9
Peak3	2.005	7.428	952.2	5.479	113.7

Peak4	2.009	6.86	185.3	6.914	815.4
Peak5	2.016	13.41	4856	20.3	609.3
Peak6	2.026	19.37	2132	14.1	563.7
Peak7	2.031	7.571	103.7	8.202	194.9
Peak8	2.04	25.44	723.8	11.08	62.59
Peak9	2.05	10.43	49.83	7.881	5.076

In principle, if the g value of the new EPR signal is smaller than 2.0023, the signal originates from the trapped electrons. Otherwise, the signal originates from the trapped holes. The $Zn_{1.976}Yb_{0.004}Li_{0.02}P_2O_7$ EPR signals in different treating processes were fitted into nine peaks which consist of two kinds of signals, two electron signals and seven hole signals. The fitting curves match well with the raw curves, although some subtle peaks still exist in the residual curves. In view of the rugged residual curves, we suppose that beyond the dominating peaks we fitted, more of additional signal sources exist in the host. However, at least qualitatively, it is manifested that the electron and hole traps are both exist.

Furthermore, according to the fitting results, most of the intensity of the signals in Fig. 1s (b) decreased compared with the signals in Fig. 1S (b), especially for peak 2, 5, 6. However, for peak 1, 4, and 7 the intensity is increased with a small amplification. We deduce that this phenomena may originate from the recapture of the holes by the traps, because that there are many hole traps in the forbidden band. And the traps in the forbidden always have a distribution. The charge carriers are easier to be recaptured by deeper traps. In addition, the error of the time-related processing is another possibility. There may be more than 9 signals for the material. The weak signals that we did not fitted will disturb the analysis to some extent. Fortunately, these signals are quite weak, which will not change the qualitative results, but is also demonstrated that the crystal defects in the materials is complex and the defects influence the luminescent properties of the Yb^{3+} to some degree. Hence, further studies are still needed.