Electronic Supplementary Material (ESI) for Inorganic Chemistry Frontiers.

Supporting Information

X-ray-activated Ultra-long UVA Persistent Luminescence from Bi-doped Perovskite $LaGaO_3$ for Photodynamic Activation

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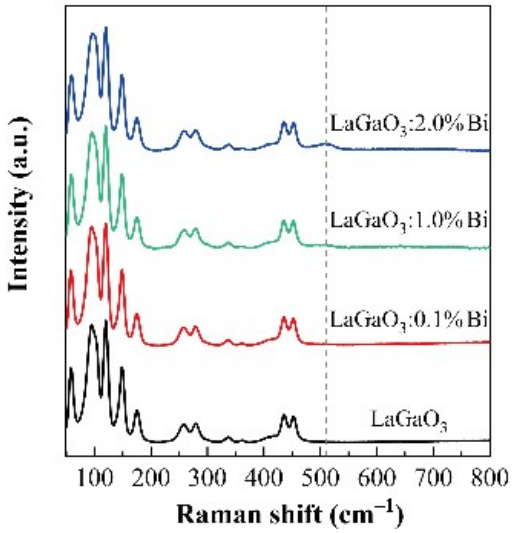

Figure S1. Normalized Raman spectra of undoped and Bi-doped $LaGaO_3$.

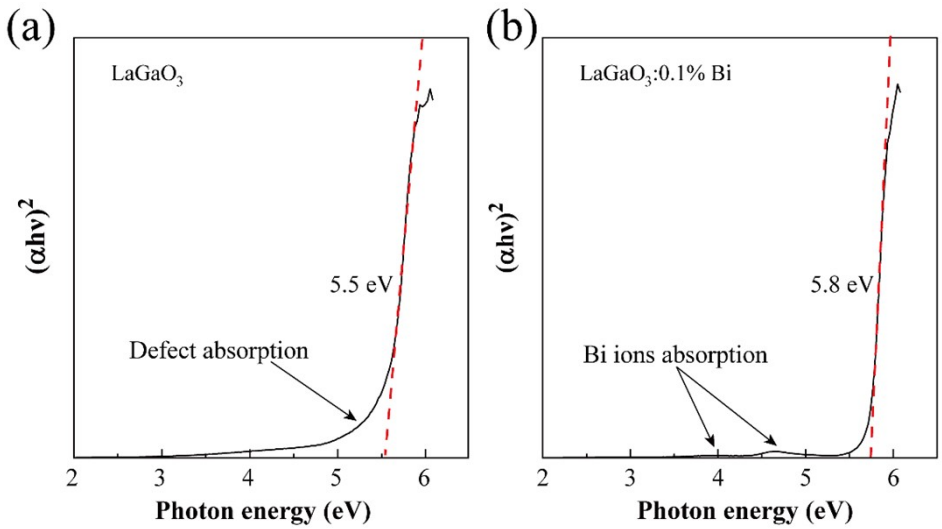

Figure S2. The plot of $(ahν)^2$ versus photon energy (hν) for direct bandgap measurements of (a) $LaGaO_3$ host and (b) $LaGaO_3$:0.1%Bi, respectively. Based on the absorption data of **Figure 6a**, the optical band gap has been calculated using the Wood and Tauc model. Note that the apparent absorption tail (Urbach tail) in the $LaGaO_3$ host comes from energy levels in defective crystalline,[1] which means that the existence of randomly distributed oxygen vacancies inevitably causes a certain degree of structural disorder.

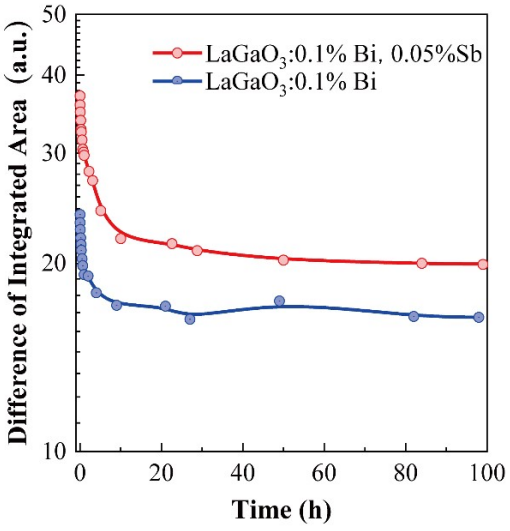

Figure S3. Time dependence of the difference of integrated absorption area ($A_{after\ irradiation}$ - $A_{before\ irradiation}$) for $LaGaO_3$: 0.1%Bi based on the data of **Figure 5b**. The sample $LaGaO_3$:0.1%Bi,0.05%Sb with the best PersL properties were tested at the same time.

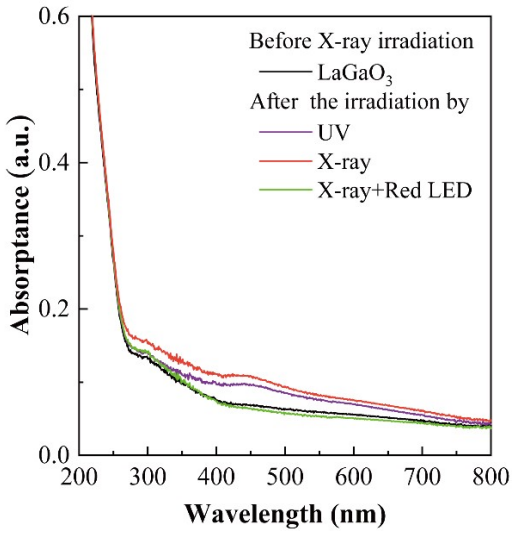

Figure S4. Absorption spectra of the as-obtained $LaGaO_3$ powder after irradiation by different excitation sources for 5min. Note: Similar thermal elimination by a red LED light can also be observed in $LaGaO_3$:0.1%Bi.

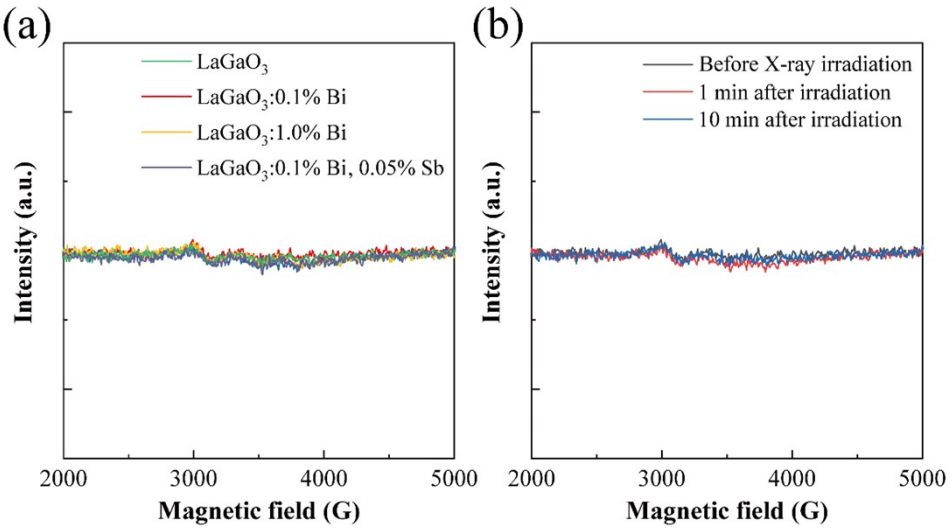

Figure S5. (a) EPR spectra of as-obtained undoped, Bi-doped, and Bi/Sb-codoped $LaGaO_3$. (b) EPR spectra of $LaGaO_3$:0.1%Bi measured at RT before and after X-ray irradiation (5min). Note that the $LaGaO_3$:Bi/Sb, which has the best PersL performance, also does not show any change during or after the X-ray irradiation, and the small peaks around G=3300 in the spectra are due to the existence of trace impurity elements, such as Cr or Mn from the raw materials.

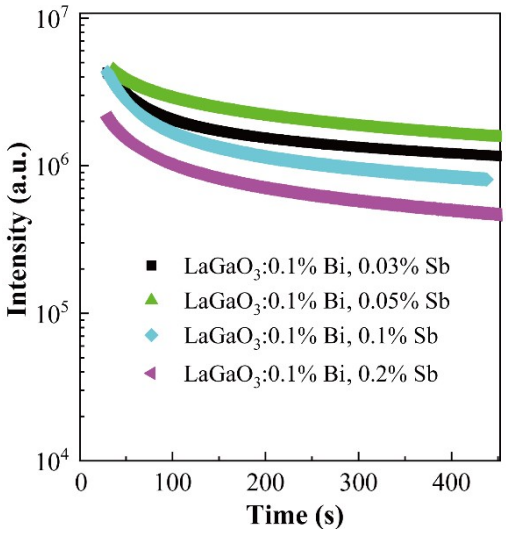

Figure S6. The persistent decay curves of $LaGaO_3$:0.1%Bi codoped with different Sb monitored at 372 nm after X-ray irradiation for 5 min.

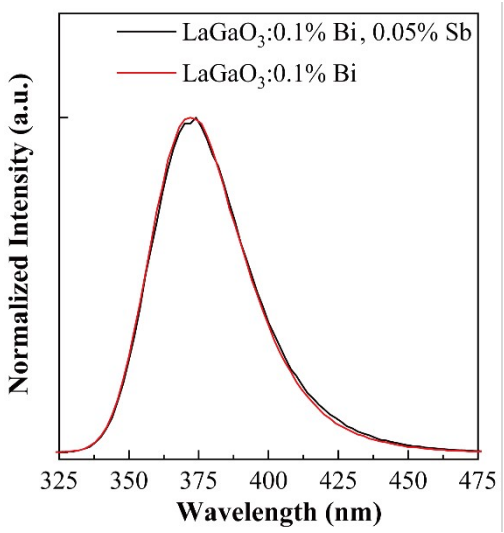

Figure S7. Emission spectra of $LaGaO_3$:0.1%Bi,0.05%Sb and $LaGaO_3$: 0.1%Bi under the X-ray excitation.

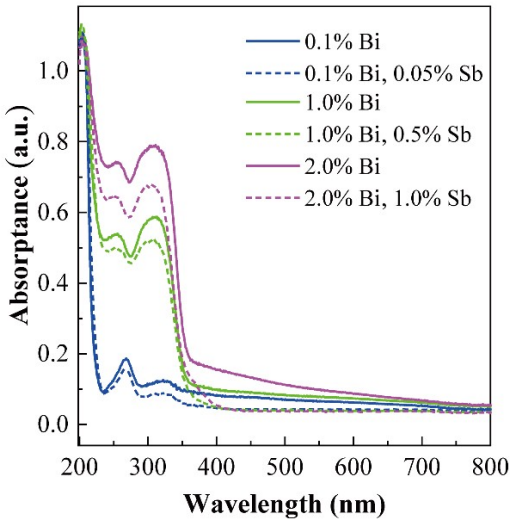

Figure S8. Absorption spectra of the as-synthesized Bi-doped and Bi/Sb codoped $LaGaO_3$ powder samples.

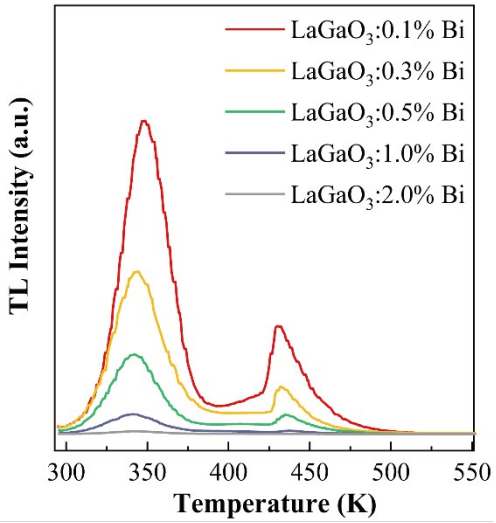

Figure S9. TL glow curves of $LaGaO_3$:*x*Bi (*x*=0.1–2%) phosphors at 10 s after X-ray charging for 5 min.

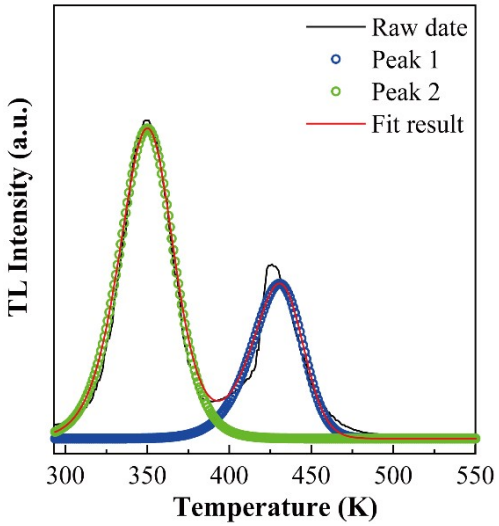

Figure S10. TL curves of $LaGaO_3$:0.1%Bi,0.05%Sb that were resolved into two bands. The depths of the trap were estimated using the following equation:[2]

$$I(T) = n_0 S \exp\left(-\frac{E}{kT}\right)\left[(b-1)(S/\beta)\int_{T_0}^{T}\exp\left(-\frac{E}{kT}\right)dT + 1\right],$$

Where T is the temperature, n_0 is the concentration of trapped charges at $T = 0$, k is Boltzmann constant, β is the heating rate, E is the activation energy (which means the trap depth), S is frequency, and b is the order of kinetics. The calculated trap depths of the oxygen vacancy are 0.78 eV and 1.12 eV, respectively.

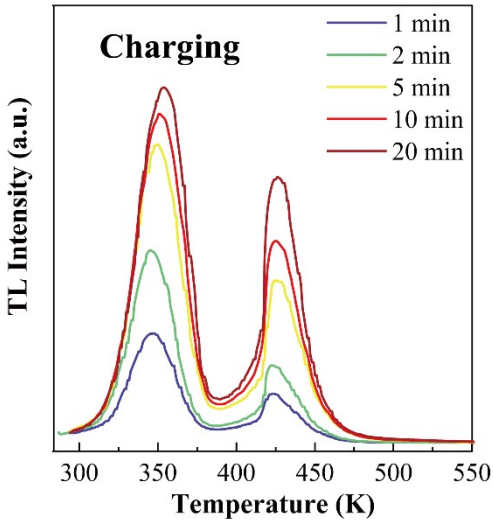

Figure S11. TL curves of the $LaGaO_3$:0.1%Bi,0.05%Sb sample measured at 10 s after initially irradiated with an X-ray light for 1, 2, 5, 10, and 20 min.

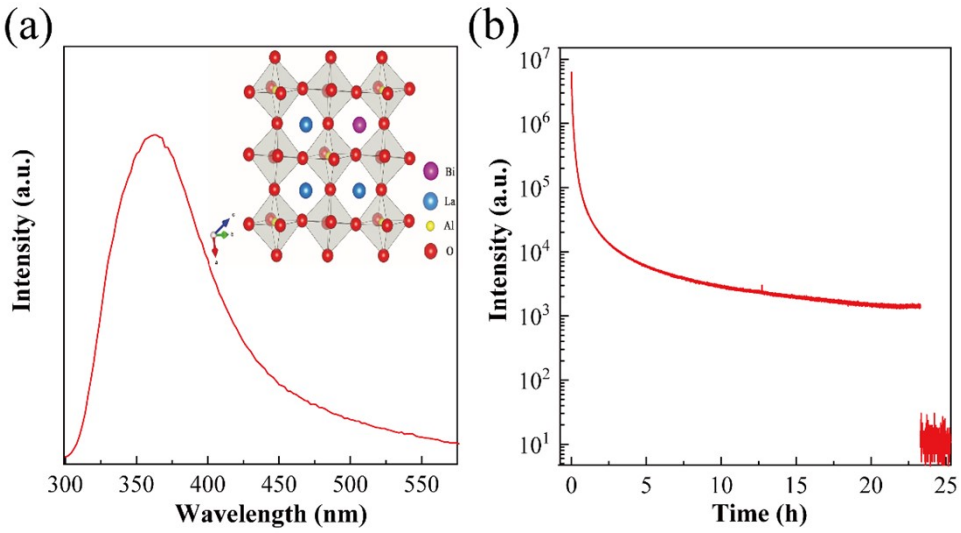

Figure S12. (a) Emission spectrum of $LaAlO_3$:1%Bi under the X-ray radiation. Inset: schematic diagram of Bi-doped $LaAlO_3$ structure. (b) PersL decay curve of $LaAlO_3$:1%Bi monitored at 361 nm after X-ray radiation for 15 min.

References

[1] Hu, C. Q.; Meng, F. F.; Wen, M.; Gu, Z. Q.; Wang, J. Y.; Fan, X. F.; Zheng, W. T., Relationship between dielectric coefficient and Urbach tail width of hydrogenated amorphous germanium carbon alloy films. *Appl. Phys. Lett.* **2012,** *101* (4), 042109.

[2] Bos, A. J. J., Theory of thermoluminescence. *Radiat. Meas.* **2006,** *41*, S45-S56.