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

Supporting Information

Energy Transfer Enhanced Broadband Near-Infrared Phosphors: Cr^{3+}/Ni^{2+} Activated $ZnGa_2O_4$–Zn_2SnO_4 Solid Solutions for the Second NIR Window Imaging

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Table S1 Refined Structural Parameters of ZSGO (y = 0, 0.1, 0.3, 0.5, 0.7, 0.9, 1) Sample.

Sample	Formula	*a*/Å	Volume/Å^3	R_{exp}	R_{wp}	R_p	GOF
ZG1	$ZnGa_2O_4$	8.3436(6)	580.85(7)	5.36	7.30	5.22	1.36
ZSG2	$Zn_{1.1}Sn_{0.1}Ga_{1.8}O_4$	8.3770(3)	587.86(5)	5.55	6.88	4.72	1.24
ZSG3	$Zn_{1.3}Sn_{0.3}Ga_{1.4}O_4$	8.4377(2)	600.73(3)	6.02	7.89	5.80	1.31
ZSG4	$Zn_{1.5}Sn_{0.5}Ga_{1.0}O_4$	8.5066(4)	615.56(5)	6.19	6.67	4.86	1.08
ZSG5	$Zn_{1.7}Sn_{0.7}Ga_{0.6}O_4$	8.5740(5)	630.31(4)	6.51	7.25	5.20	1.11
ZSG6	$Zn_{1.9}Sn_{0.9}Ga_{0.2}O_4$	8.6351(8)	643.89(2)	6.79	7.57	5.51	1.11
ZS7	Zn_2SnO_4	8.6694(9)	651.60(2)	4.73	6.80	5.08	1.44

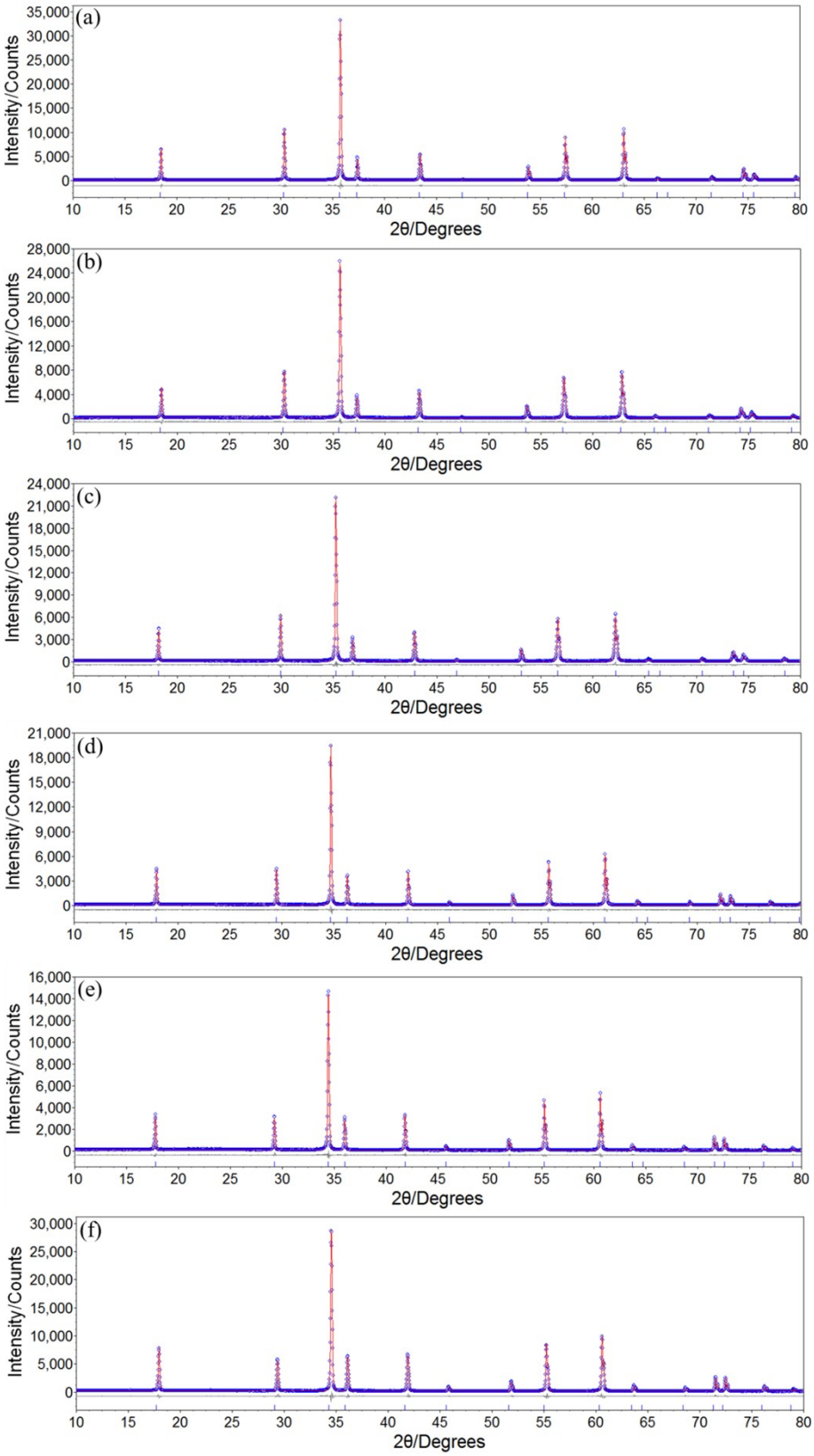

Fig. S1 (a-f) Measured (blue dots) and calculated (red line) powder XRD patterns as well as difference profile (grey line) and the Bragg reflection positions (blue short vertical lines) for Rietveld refinements of $Zn_{1+x}Sn_xGa_{2-2x}O_4$ (y = 0， 0.1, 0.3, 0.7, 0.9， 1).

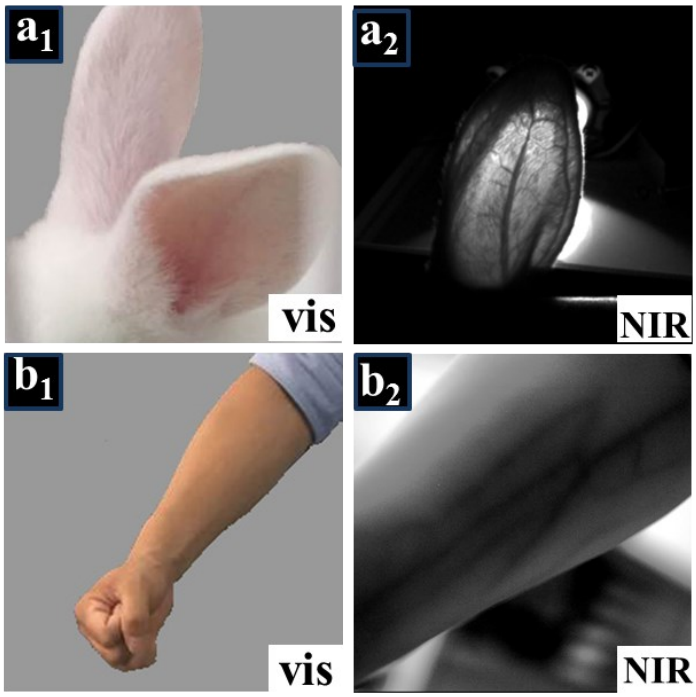

Fig. S2 (a) and (b) The optical images of blood vessels in the rabbit ear and human arm.

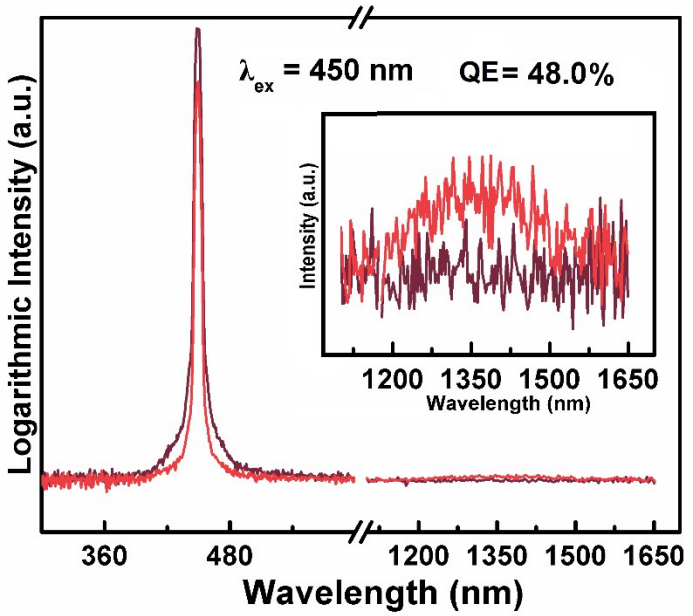

Fig. S3 Absorption and emission spectra of $Zn_{1.5}Sn_{0.5}Ga_{1.0}O_4$: $0.14Cr^{3+}$, $0.008Ni^{2+}$ for QE measurement by 450 nm excitation.

The internal QE was obtained by the following equation:

$$iQE = \frac{\int \lambda P(\lambda) d\lambda}{\int \lambda \{E(\lambda) - R(\lambda)\} d\lambda}$$

where E(λ)/hv, R(λ)/hv, and P(λ)/hv are the numbers of photons in the excitation, reflectance, and emission spectra of the phosphor respectively. [1]

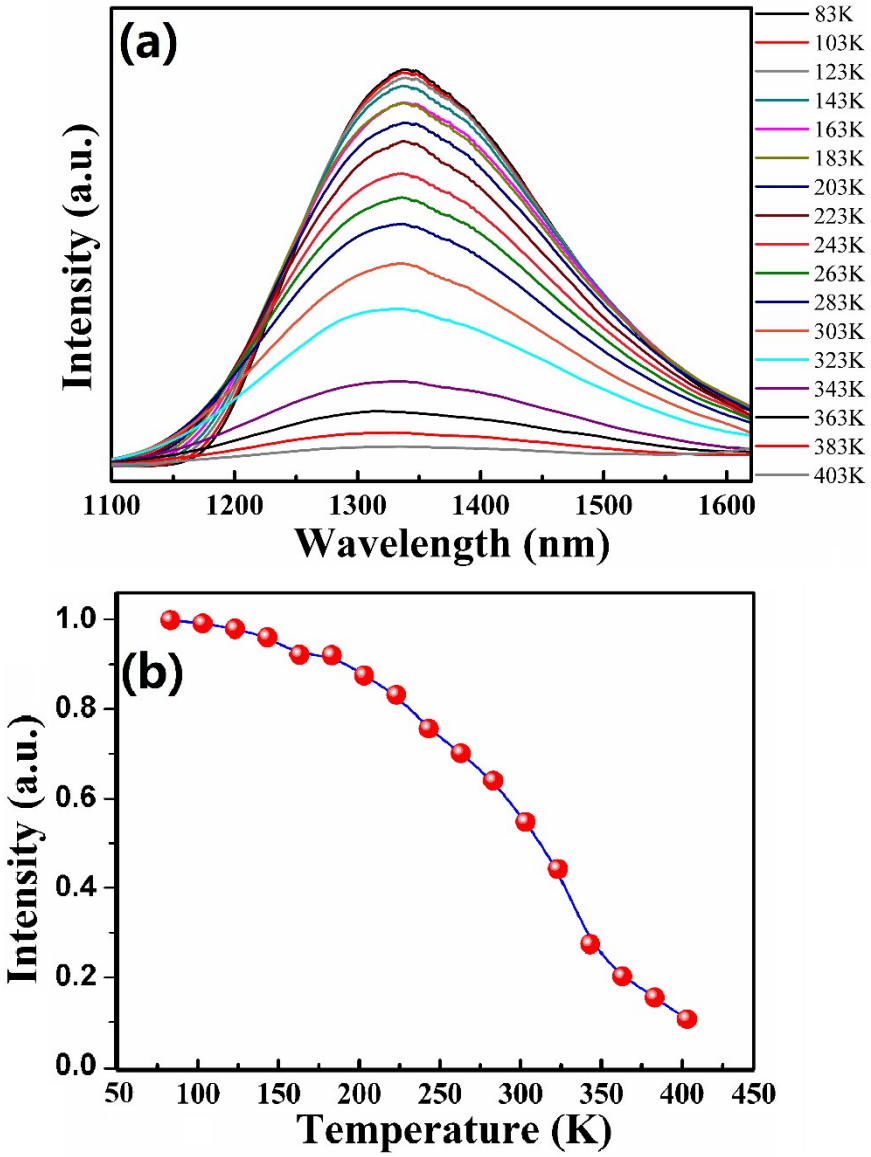

Fig. S4 (a) PL spectra of Ni^{2+} in $Zn_{1.5}Sn_{0.5}Ga_{1.0}O_4$: $0.14Cr^{3+}$, $0.008Ni^{2+}$ with the temperature increasing from 83 to 403 K. (b) PL intensity values of $Zn_{1.5}Sn_{0.5}Ga_{1.0}O_4$: $0.14Cr^{3+}$, $0.008Ni^{2+}$ at different temperatures.

References

1. T. Takeda, N. Hirosaki, S. Funahshi and R.-J. Xie, Chem Mater, 2015, 27, 5892-5898.