

**Multifunctional Optical Materials Based on Transparent Inorganic
Glasses Embedded with PbS QDs**

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1. Experimental Procedures

Chemicals: Silicon dioxide(SiO_2 , 99.9%, Aladdin), Germanium dioxide(GeO_2 , 99.99%, Aladdin), Boracic acid(H_3BO_3 , 99.99%, Aladdin), Aluminium oxide(Al_2O_3 , 99.99%, Aladdin), Zinc fluoride(ZnF_2 , 99.9%, Aladdin), Sodium fluoride(NaF , 99.99%, Aladdin), Sodium carbonate(Na_2CO_3 , 99.99%, Aladdin), Lead oxide(PbO , 99.99%, Aladdin), Zinc selenide(ZnS , 99.99%, Aladdin), Thulium oxide(Tm_2O_3 , 99.9%, Shenyang Feichuang Photoelectric Technology), all the chemicals were purchased and used without further purification.

Synthesis: The nominal composition of the glasses involved in the article were shown in Table S1. All the raw materials are mixed uniformly in an agate mortar and then placed in a corundum crucible, and melted in a resistance furnace at 1400 °C for 40 minutes. The obtained melt is quenched and pressed on a preheating plate at 400 °C and then annealed or heat-treated in an annealing furnace to obtain the initial samples. The glass samples for the optical property measurement were cut and optically polished to a size of 10×10×1 mm³. Glass samples for structural testing were ground to a fine powder using an agate mortar.

2. Figures

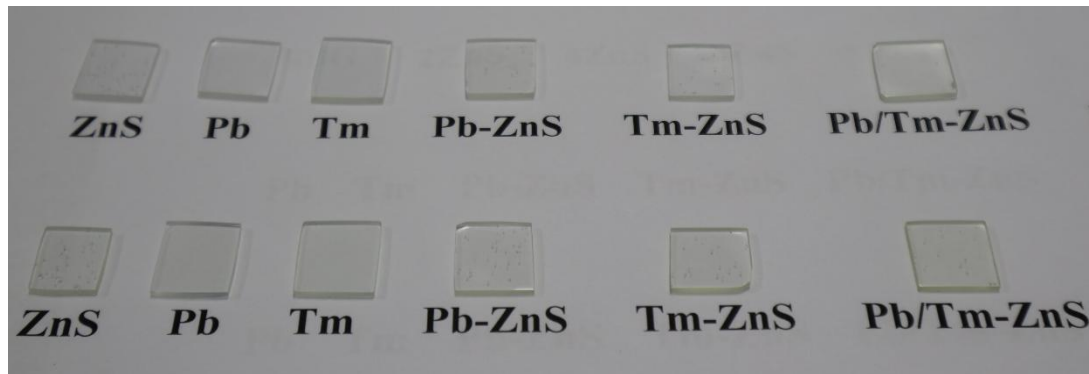


Figure S1. Actual photos of different doped samples before(above) and after(below) heat treatment

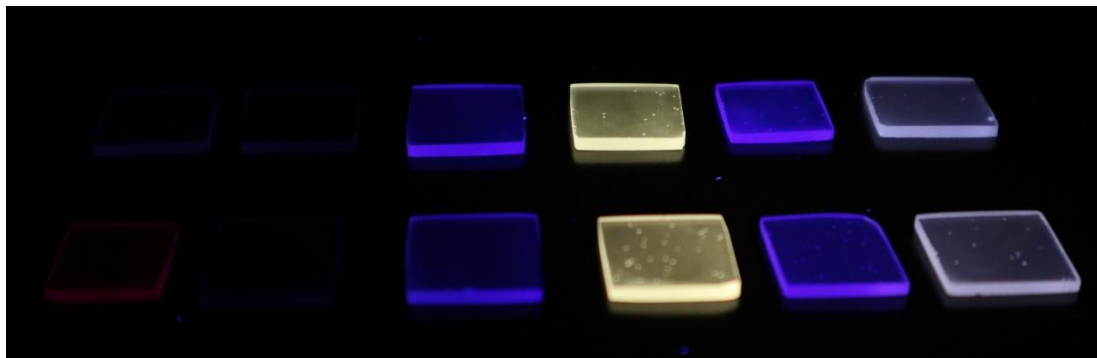


Figure S2. Actual photos of different doped samples(Corresponding to the doping conditions in Figure S1) under UV lamp irradiation before(above) and after(below) heat treatment

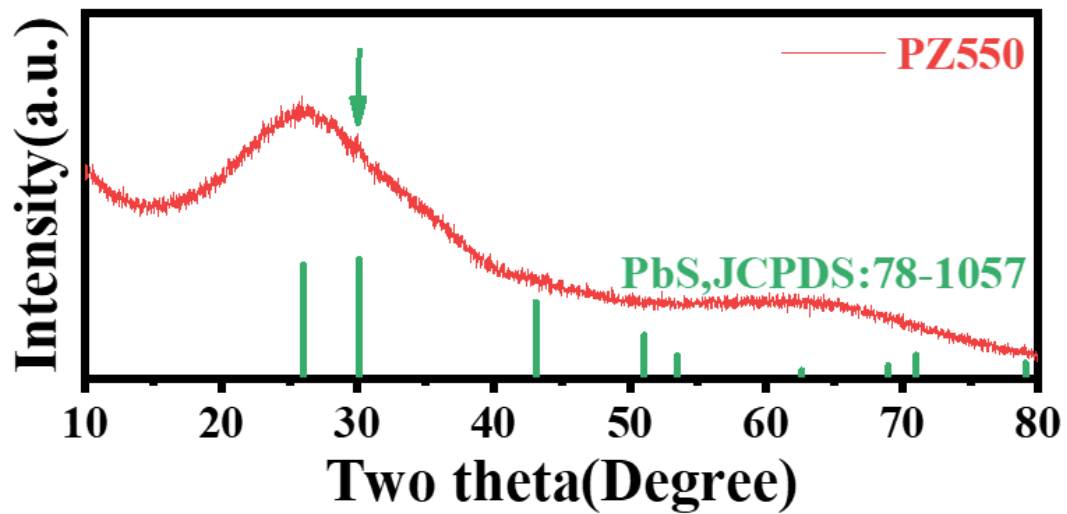


Figure S3. XRD pattern of PZ550 sample (after heat treatment at 550 °C for 12h)

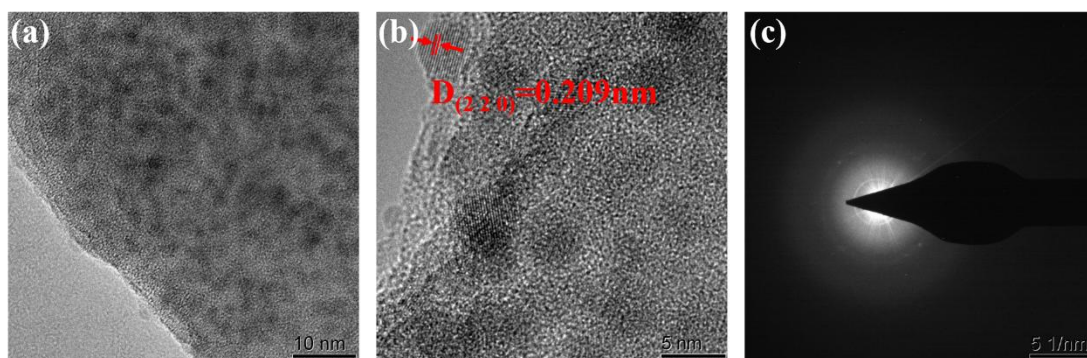


Figure S4. HRTEM images (a, b) and the corresponding SAED pattern (c) of the PZ550 sample

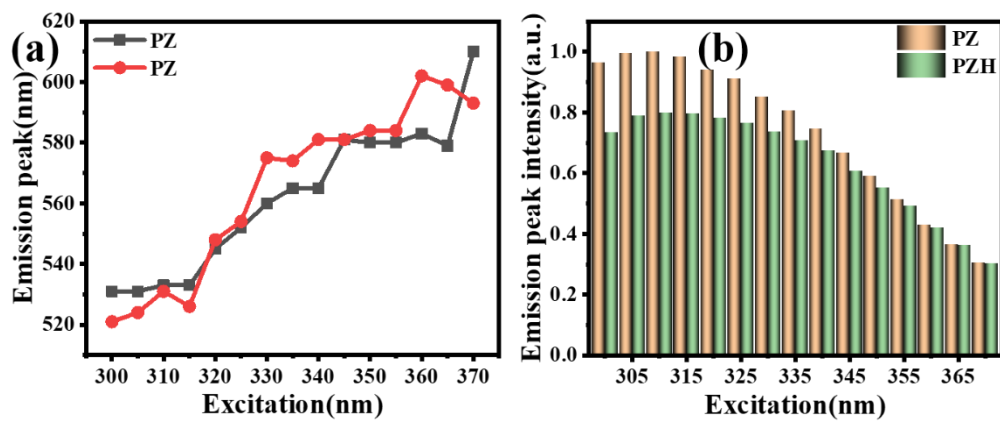


Figure S5. Comparison of emission peaks (a) and intensities (b) depending on excitation wavelength

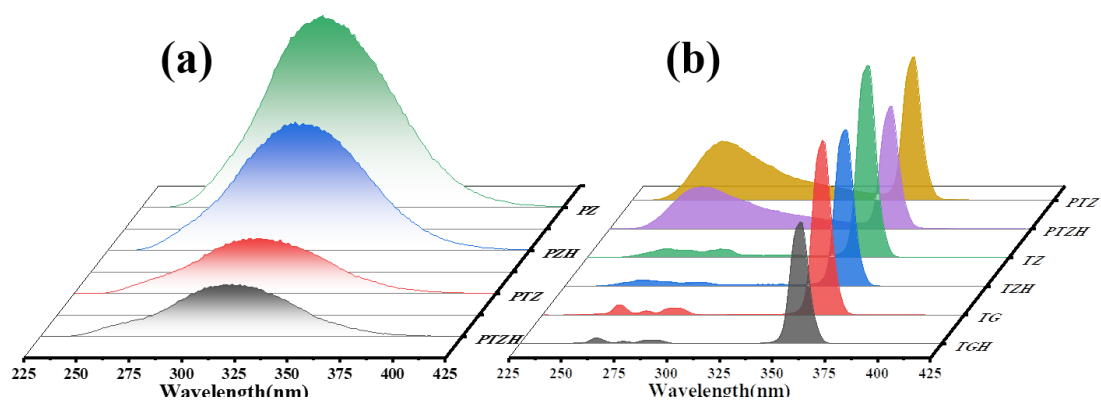


Figure S6. Excitation spectra of the different samples with fluorescence at 458 nm(a) and 560 nm(b).

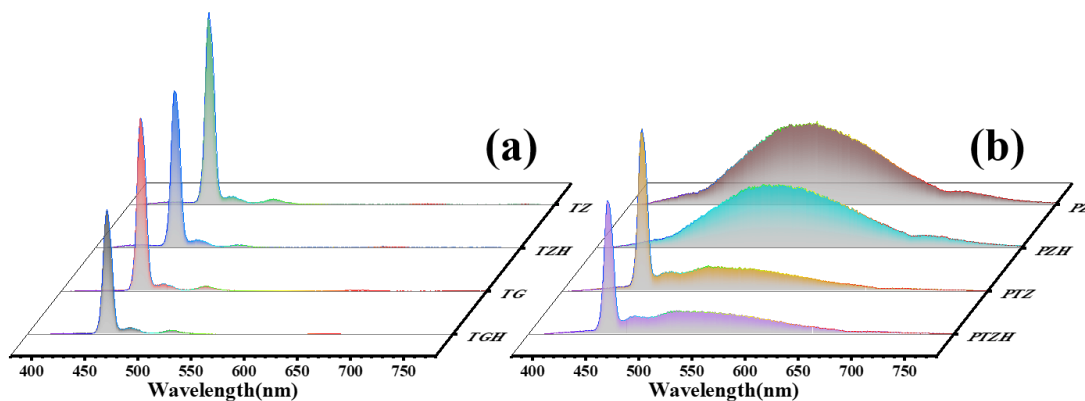


Figure S7. Photoluminescence spectra of the different samples under 365 nm pumping.

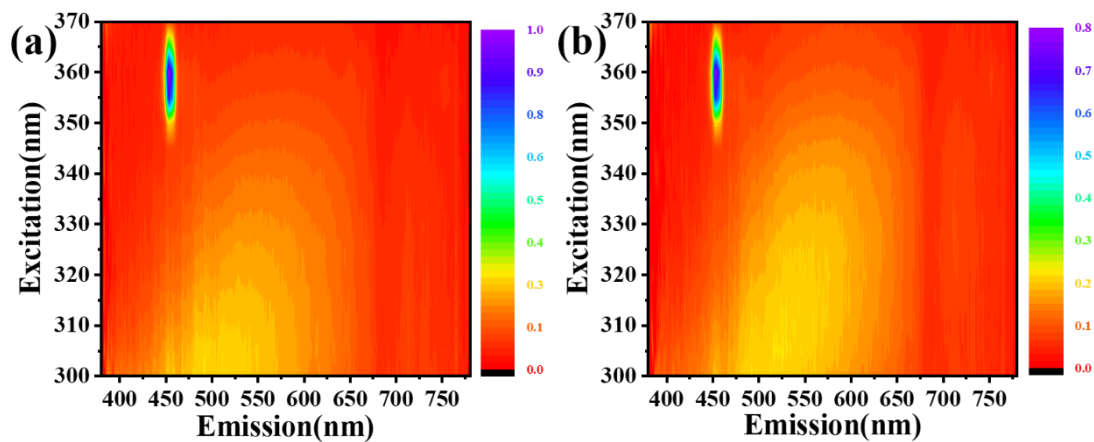


Figure S8. Excitation wavelength-dependent photoluminescence spectra of PTZ (a) and PTZH (b) samples under 300-370 nm pumping.

3. Tables

Table S1 The doping of different samples and their nomenclature

	Host glass	ZnS(mol%)	PbO(mol%)	Tm ₂ O ₃ (mol%)	Heat-treatment
PG					400°C for 12h
PGH					500°C for 12h
ZG		2	1		400°C for 12h
ZGH	30SiO ₂	2	1		500°C for 12h
PbG	-20GeO ₂		1		400°C for 12h
PbGH	-10B ₂ O ₃		1		500°C for 12h
TG	-15Al ₂ O ₃			0.5	400°C for 12h
TGH	-10ZnF ₂			0.5	500°C for 12h
PZ	-10NaF	2	1		400°C for 12h
PZH	-5Na ₂ O	2	1		500°C for 12h
TZ		2		0.5	400°C for 12h
TZH		2		0.5	500°C for 12h
PTZ			1	0.5	400°C for 12h
PTZH			1	0.5	500°C for 12h

Table S2 The detailed fitting results of different samples at 560 nm emission

PARAMETER	PZ	PZH	PTZ	PTZH
A ₁	0.33311	0.28914	0.59966	0.54083
t ₁	1.13098	0.62832	0.94443	0.65407
A ₂	0.57032	0.56218	0.41246	0.42462
t ₂	4.90147	4.06573	4.21831	3.83952
A ₃	0.13959	0.17352	0.0687	0.10695
t ₃	17.41063	15.34561	14.2201	13.91215
R ²	0.99936	0.99951	0.9977	0.99788
τ (μs)	10.07	9.80	6.63	7.83

Table S3 The detailed fitting results o of different samples at 458 nm emission

PARAMETER	TG	TGH	TZ	TZH	PTZ	PTZH
A₁	0.37813	0.40891	0.33001	0.43993	0.31358	0.632
t₁	0.34174	1.16903	0.22895	0.23451	0.29681	0.99315
A₂	0.33168	0.67647	0.34748	0.25345	0.35493	0.33272
t₂	5.52973	18.26388	5.73615	5.53135	4.74803	8.72692
A₃	0.33808	0.00988	0.35489	0.34562	0.35802	0.15954
t₃	16.82506	65.44539	16.59093	18.41751	15.60226	21.65503
R²	0.99936	0.99601	0.99955	0.9993	0.99962	0.99366
τ (μs)	13.84	19.92	13.72	15.88	12.92	14.43