

Enhancement of photoacoustic and upconversion emission in $\text{Mg}^{2+}/\text{Zn}^{2+}$ codoped $\text{Gd}_2\text{O}_3:\text{Er}^{3+}/\text{Yb}^{3+}$ phosphor using 980 nm excitation

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Supplementary

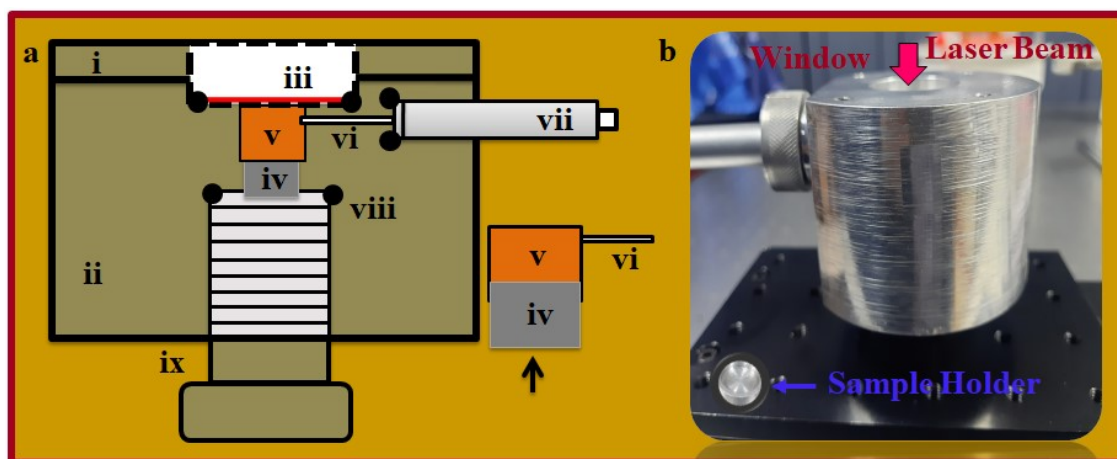


Fig. S1 (a) Schematic diagram of PA cell, (i) Covering plate, (ii) Main cell body, (iii) Quartz window, (iv) Sample holder, (v) Sample chamber, (vi) Channel, (vii) Microphone, (viii) O-ring, (ix) Thick back screw, (b) Fabricated PA cell in laboratory.

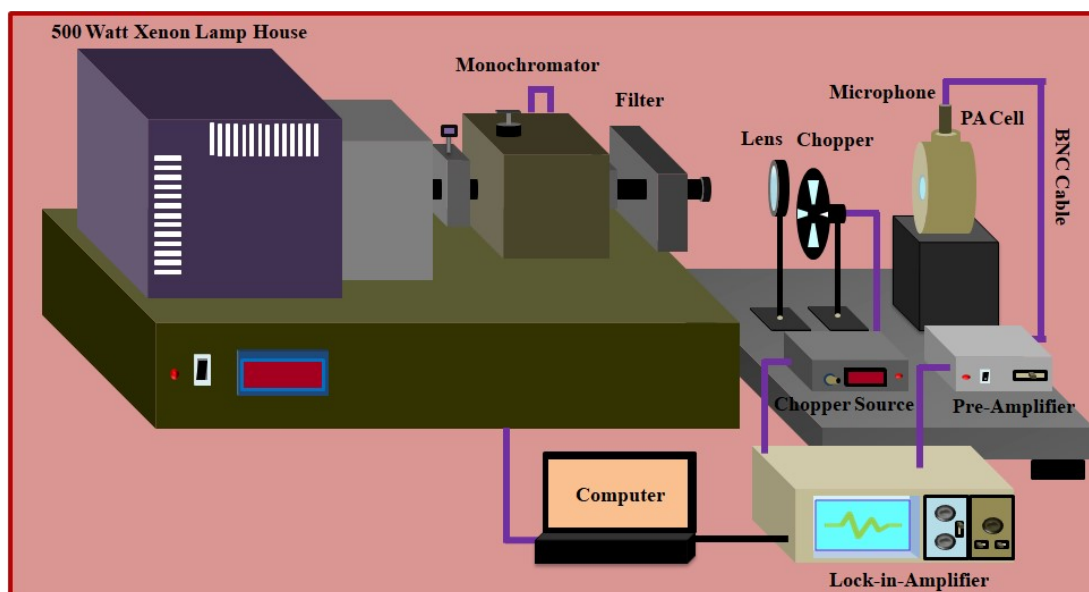


Fig. S2 Full experimental setup for recording of PA absorption spectra and a software controlled spectrograph assembled with 500 Watt Xenon lamp for sample excitation.

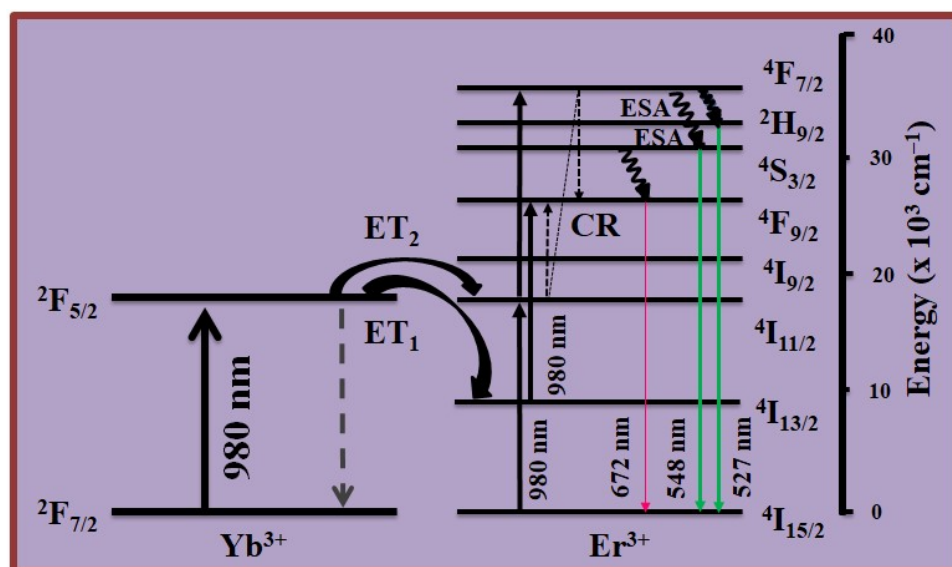


Fig. S3 Schematic energy levels diagram of Yb³⁺/Er³⁺ system.

Table S1 Data for comparative study of PA amplitudes and UC emission intensities with pump power.

Power (mW)	PA amplitudes (mV)	UC intensity (a.u.)		
		527 nm (${}^2\text{H}_{11/2} \rightarrow {}^4\text{I}_{15/2}$)	548 nm (${}^4\text{S}_{3/2} \rightarrow {}^4\text{I}_{15/2}$)	672 nm (${}^4\text{F}_{9/2} \rightarrow {}^4\text{I}_{15/2}$)
2.24	0.104	210	214	211
5.45	0.116	211	232	219
10.6	0.152	236	343	276
13.6	0.168	248	392	300
17.4	0.176	261	450	331
21.6	0.188	276	526	367
24.7	0.208	295	658	406
28.8	0.228	321	719	460
33	0.264	360	883	539
37.2	0.292	381	983	584
41.1	0.316	420	1146	658
45.9	0.340	465	1327	742
50.9	0.352	487	1435	790
53.8	0.364	521	1558	843
58.5	0.400	582	1802	952
62.2	0.424	607	1904	983
66.3	0.444	667	2127	1089
71.8	0.464	680	2178	1115
74.1	0.476	729	2371	1194
79.3	0.512	788	2594	1290
83.8	0.540	830	2736	1354
87.3	0.590	946	3130	1517
91	0.608	969	3241	1565
94.7	0.624	1012	3398	1632
115	0.744	1283	4271	1992
135	0.864	1615	5280	2386
158	1.010	1925	6146	2713
177	1.180	2362	7171	3090
198	1.320	2766	8027	3428
217	1.460	3208	8837	3723
240	1.620	3665	9718	4030
259	1.760	4162	10387	4227
305	2.040	5188	11764	4692
350	2.340	6272	12987	5126
391	2.620	7398	13935	5206
436	2.920	8470	14618	5595
472	3.200	9321	14924	5657
516	3.560	10171	15069	5643
558	3.800	10771	14833	5528
603	4.160	11272	14100	5266
647	4.520	11697	13481	5029

690	4.920	11803	12389	4700
736	5.280	11581	11277	4200
782	5.840	11550	10209	4004
816	6.320	11136	8892	3615
862	6.640	10764	7978	3332
907	7.040	10393	7220	3073
950	7.440	10242	6646	2890
995	7.760	9921	6100	2690
1040	8.080	9650	5601	2512