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Enhanced Mechanically Induced Red-light Emission Novel Mechanoluminescence Material for Ultrasonic Visualization and Monitoring Application

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Table S1. The Refinement data for $Ca_{1-x}Sr_xZn_{0.98}OS:Mn^{2+}$ ($x = 0, 0.03, 0.09, 0.15, 0.30$)

	0	0.03	0.09	0.15	0.30
Space group	$P6_3mc$	$P6_3mc$	$P6_3mc$	$P6_3mc$	$P6_3mc$
a, b/Å	3.75650(12)	3.75650(12)	3.76691(12)	3.77369(24)	3.80338(22)
c/Å	11.40344(38)	11.40344(38)	11.42103(41)	11.42154(72)	11.46459(70)
V/Å^3	139.358(8)	139.709(7)	140.348(8)	140.860(15)	143.625(15)
R_p/%	5.53	5.93	6.72	5.46	5.62
R_{wp}/%	7.65	8.07	9.14	7.54	7.80
R_{exp}/%	5.59	4.14	5.29	3.88	3.66
χ^2	1.87	3.79	2.99	3.78	4.53
d(Zn-S)/Å	2.3717(9)	2.3723(9)	2.3777(14)	2.3832(14)	2.3979(18)
d(Zn-O)/Å	1.8941(46)	1.8962(57)	1.9030(1)	1.8937(57)	1.9102(1)
d(Ca-O)/Å	2.2838(16)	2.2841(19)	2.281(1)	2.2834(20)	2.3029(14)

Table S2. The quantity of all elements of $Ca_{0.7}Sr_{0.3}Zn_{0.98}OS:Mn^{2+}$

Element	Atomic percentage
O	29.77
S	21.78
Ca	12.59
Mn	0.02
Zn	27.47
Sr	8.37
Total	100.00

Table S3. The detailed trap depth and temperature consequence from ThL fitting peaks

***x* = 0**	**Trap depth (eV)**	**Temperature (K)**	***S***	***b***	***x* = 0.06**	**Trap depth (eV)**	**Temperature (K)**	***S***	***b***
Trap1	0.118	140.76	10^3	3	Trap1	0.124	146.46	10^3	2
Trap2	0.195	197.96	10^3	1.93	Trap2	0.185	190.61	10^3	2
Trap3	0.395	226.62	10^7	1.13	Trap3	0.284	223.73	10^5	2
Trap4	0.534	251.17	10^9	2	Trap4	0.336	261.09	10^5	2
Trap5	0.594	281.31	10^9	1.77	Trap5	0.664	301.38	10^9	2
Trap6	0.663	310.27	10^9	2	Trap6	0.729	345.71	10^9	2

***x*=0.15**	**Trap depth (eV)**	**Temperature (K)**	***S***	***b***	***x* = 0.30**	**Trap depth (eV)**	**Temperature (K)**	***S***	***b***
Trap1	0.179	180.39	10^3	2	Trap1	0.304	213.38	10^5	3
Trap2	0.281	223.61	10^5	2	Trap2	0.481	251.28	10^8	3
Trap3	0.421	259.27	10^7	2	Trap3	0.556	277.28	10^8	1.81
Trap4	0.516	290.92	10^7	2	Trap4	0.694	300.82	10^{10}	1.79
Trap5	0.621	330.58	10^8	2	Trap5	0.752	329.08	10^{10}	3
Trap6	0.831	382.19	10^9	2	Trap6	0.943	390.77	10^{11}	3

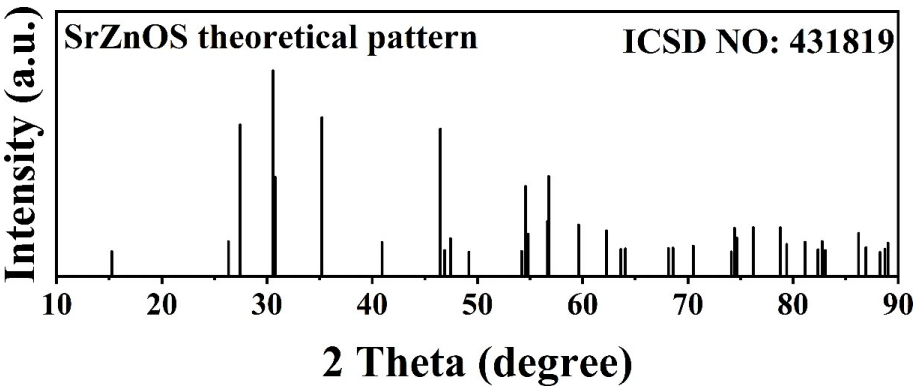

Figure S1. The SrZnOS theoretical pattern (ICSD no.: 431819)

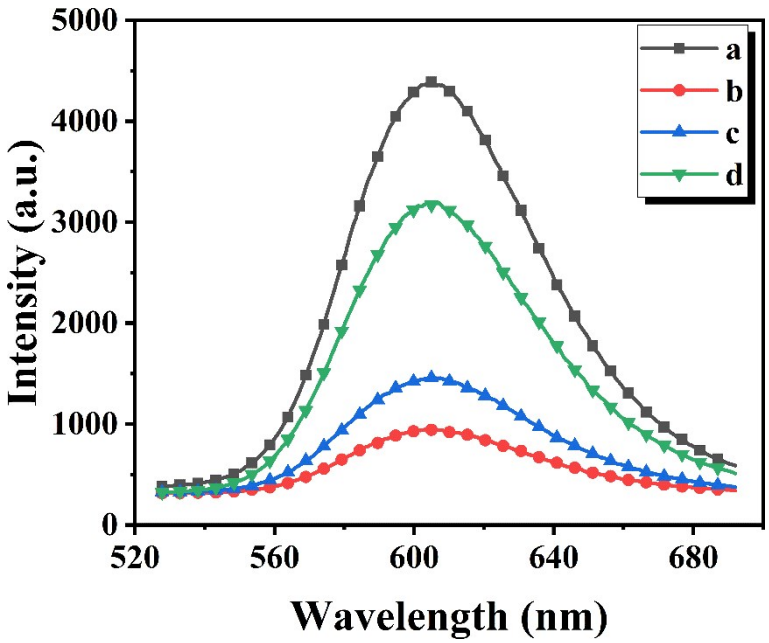

Figure S2. The emission spectra under ultrasonic excitation at different depths

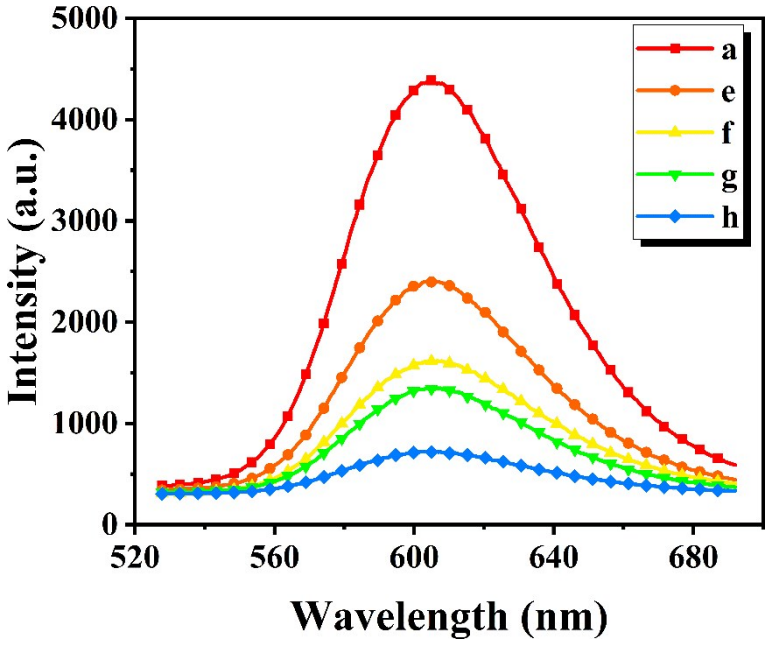

Figure S3. The emission spectra under ultrasonic excitation at different positions on the water surface

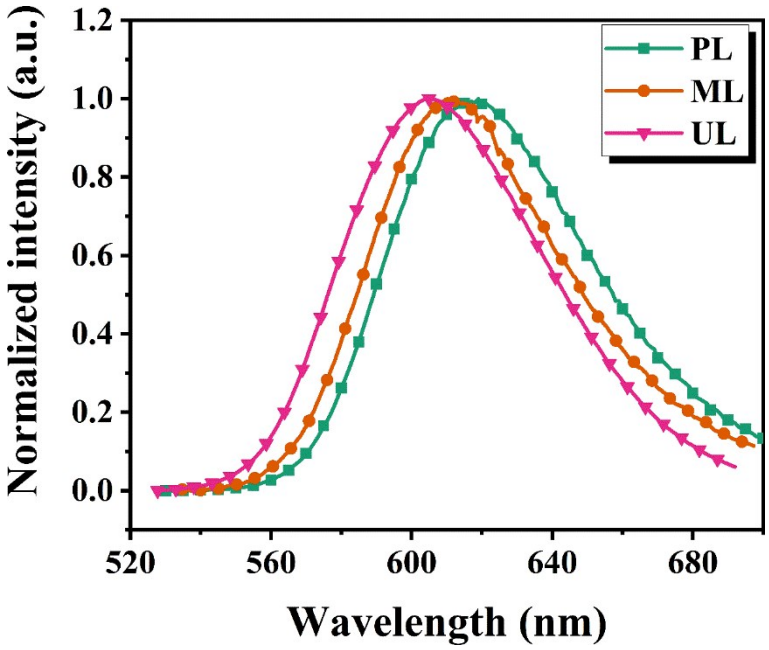

Figure S4. The normalized luminescence spectra of different excitation modes

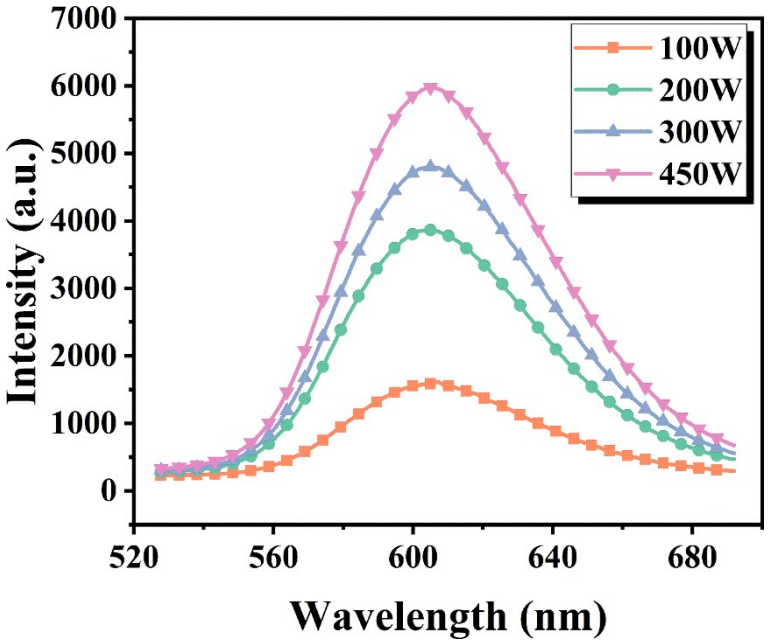

Figure S5. The emission spectra under ultrasonic excitation at different powers