

Supporting Information

Synthesis, Characterization and Application of Luminescent Silica Nanomaterials

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S1. Synthesis of Zinc Oxide Nanoparticles (ZnO NPs)

ZnO nanoparticles were synthesized based on a reported procedure. Zn(OAc)₂ solution (0.1 M, 50 mL) and polyvinylpyrrolidone (PVP) (0.05 M, 50 mL) solutions were mixed under continuous stirring. LiOH solution (1.0 M) was added dropwise to adjust the pH to 12 and the reaction was allowed to proceed for 3 hrs under reflux condition, cooled to room temperature before centrifuging for 15 mins to collect the solid ZnO particles. The particles were washed twice with ethanol (30 ml) and water (30 ml) before drying in an oven at 70 °C for 6 hrs.

Table S1. Summary of reactants used for the synthesis of ZnOSiO₂ NPs of different Zn²⁺ Loading.

Sample	No. of moles of Zn ²⁺ added (mmol)	No. of moles of AEAPTMS added (mmol)	Volume of NH ₄ OH added (μL)	Volume of TEOS added (μL)
ZnOSiO₂-1	0.075	0.075	600	400
ZnOSiO₂-2	0.15	0.15	600	400
ZnOSiO₂-3	0.30	0.15	600	400
ZnOSiO₂-4	0.45	0.15	600	600
ZnOSiO₂-A	0.45	-	600	600

ZnOSiO₂-1, ZnOSiO₂-2, ZnOSiO₂-3, ZnOSiO₂-4 refers to different amount of Zn in silica nanoparticles in the presence of AEAPTMS and sample ZnOSiO₂-A refers to Zn loaded in silica nanoparticles in the absence of AEAPTMS

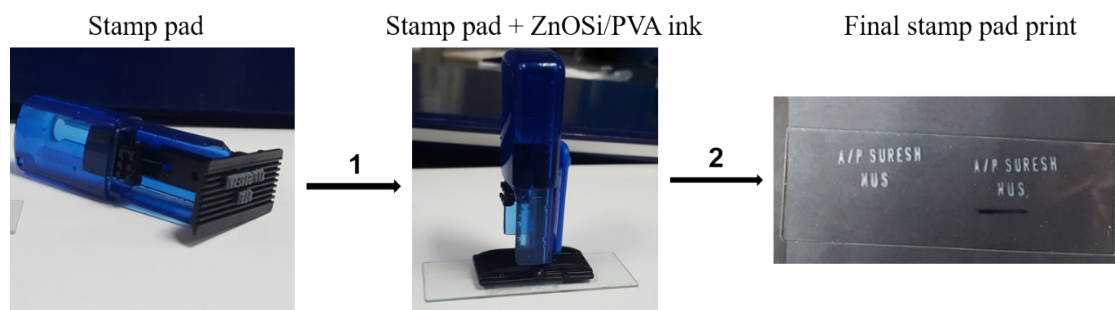


Fig. S1 Demonstration to show the printing process by stamp pad method. Required print is created on stamp pad and pressed on glass plate smeared with ZnOSiO₂/PVA formulated ink (1) for 5-10 seconds and transferred to clean glass slide to get the desired pattern on glass substrate (2).

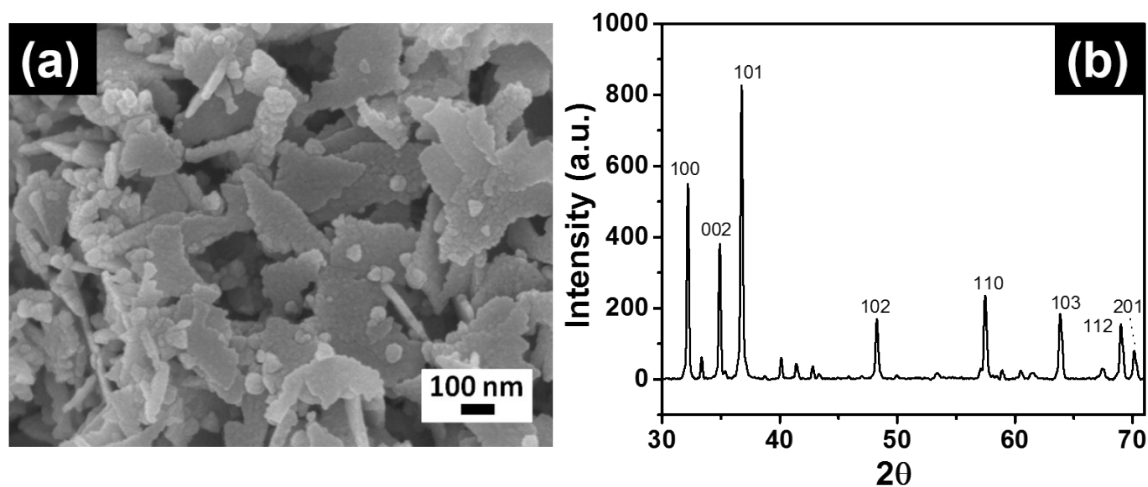


Fig. S2 SEM image (a) and XRD pattern (b) of bare ZnO NPs.

Table S2. Elemental Analysis of ZnOSiO₂ NPs.

Sample	Zn (wt %)	Si (wt %)
ZnOSiO ₂ -1	3.28	45.48
ZnOSiO ₂ -2	4.88	27.88
ZnOSiO ₂ -3	7.98	27.26
ZnOSiO ₂ -4	11.50	17.45
ZnOSiO ₂ -A	9.01	19.47

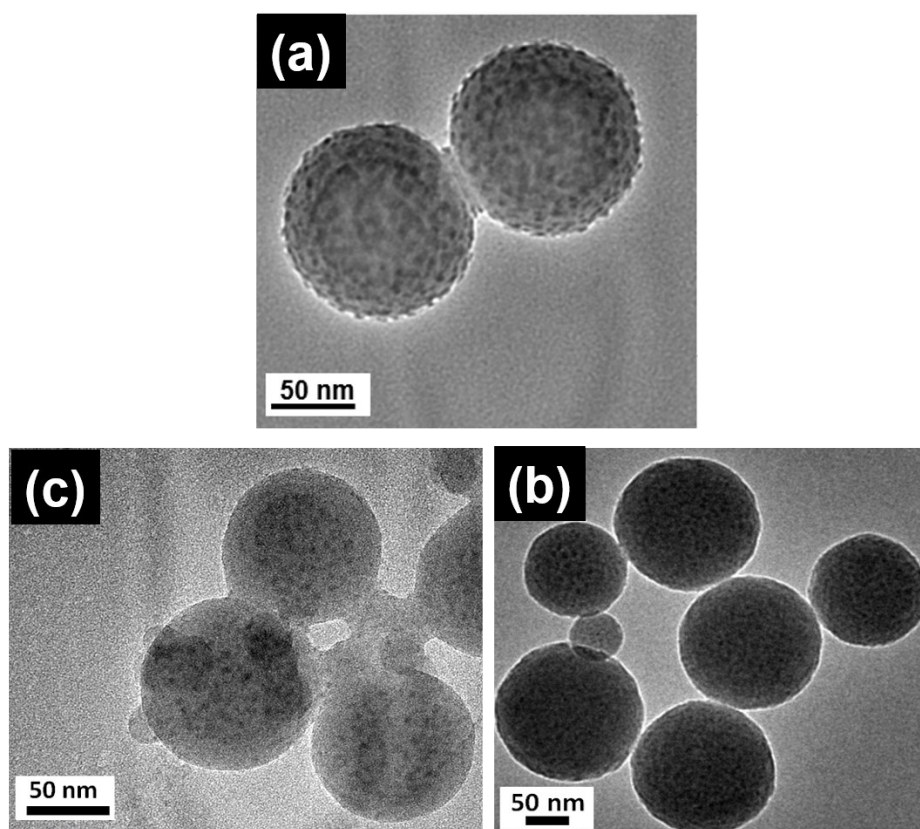


Fig. S3 TEM images of (a) ZnOSiO₂-A, (b) ZnOSiO₂-1 and (c) ZnOSiO₂-4 to show distribution of ZnO in silica matrix.

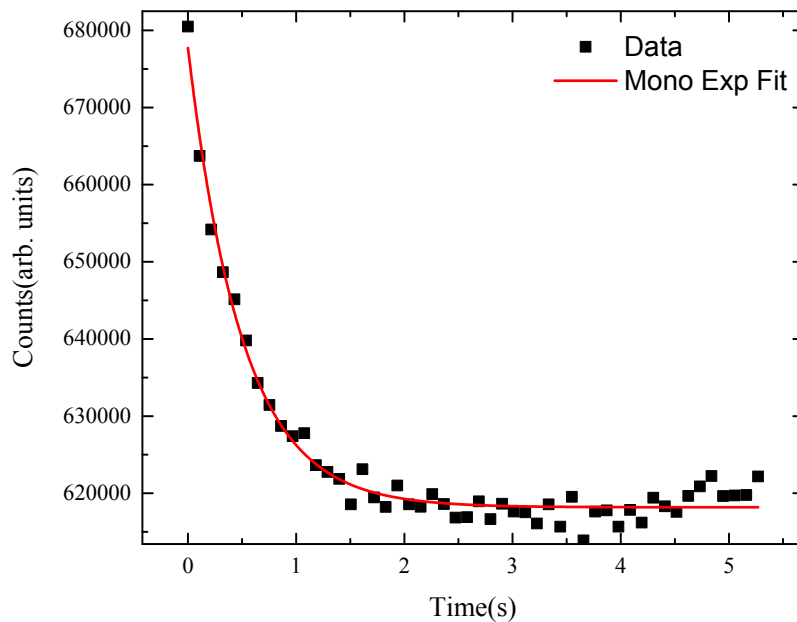


Fig. S4 Phosphorescence life time of ZnOSiO₂ – 4 nanoparticles using 405 nm as excitation wavelength.

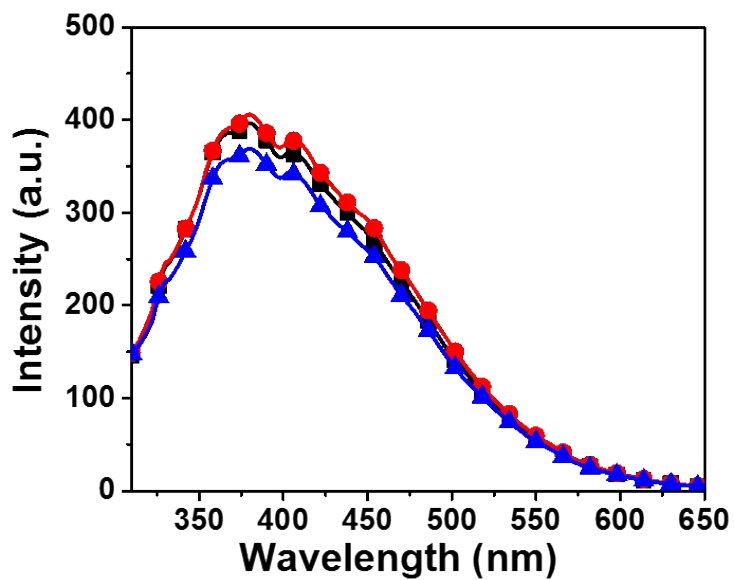


Fig. S5 Thermal Stability of ZnOSiO₂ - 1/PVA film on glass substrate heated at 100 deg at different interval of time, (■) 0 hr, (●) 1 hr, (▲) 48 hr. ($\lambda_{ex} = 300$ nm)