Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

Investigation of Emission Behaviour of Perovskite Nanocrystals into TiO_2 Nano to Microsphere

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Table S2. Calculation of lowest unoccupied molecular orbital (LUMO) and highest occupied molecular orbital (HOMO) value of PNC-Tm, PNC and PNC-Tn.

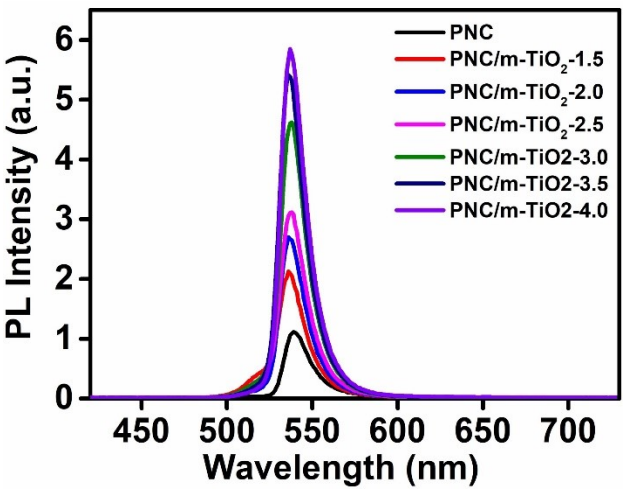

Figure S1. The PL emission spectra of PNC/m-TiO_2 with increment in loading amount of TiO_2 solution.

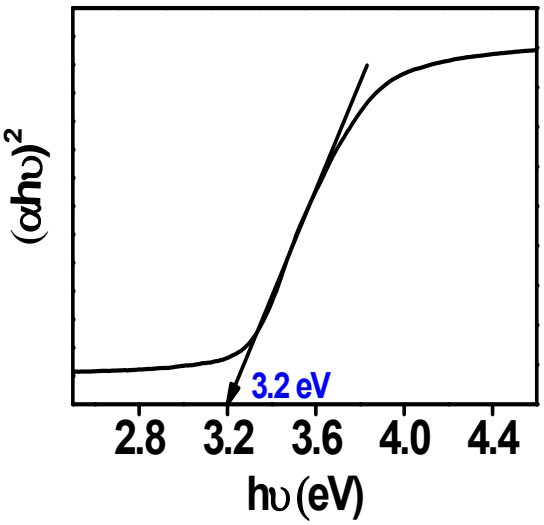

Figure S2. DRS of prepared TiO_2 microspheres with a bandgap of 3.2 eV by using an integrated sphere.

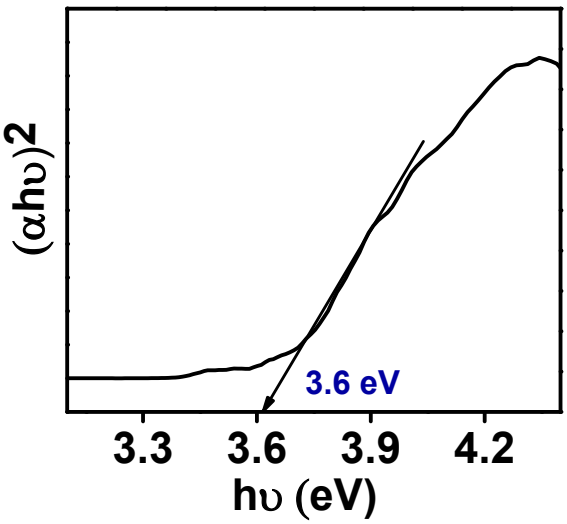

Figure S3. DRS of prepared TiO_2 nanosparticles with a bandgap of 3.6 eV by using an integrated sphere.

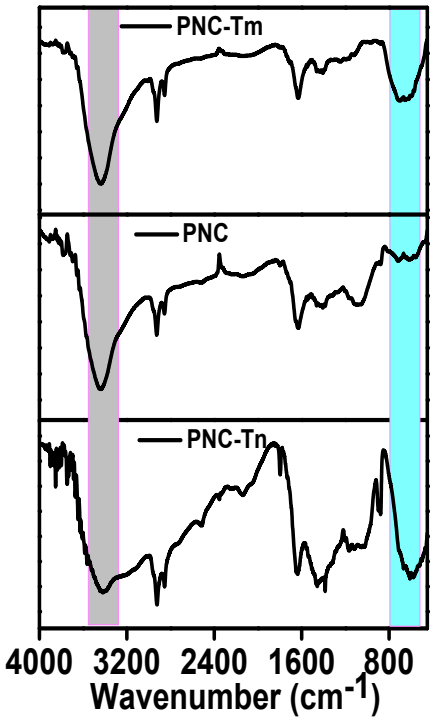

Figure S4. FTIR spectra of PNC-Tm, PNC and PNC-Tn shows the presence of functional group corresponding to the ligands. Whereas, PNC-Tm and PNC-Tn, show additional stretching vibrational frequency at 604 cm^{-1} correspond to Ti-O-Ti indicating the titanium network present around the perovskite nanocrystals.

Table S1. Details of IR peak corresponding to PNC-Tm, PNC and PNC-Tn shows the presence of functional group corresponding to ligands.

S. No	Wavenumber (cm^{-1})	Corresponding functional group
1	3441	Broad peak of -N-H strectching
2	2925	Symmetric strectching vibration of CH_2
3	2856	Asymmetric strectching vibration of CH_3
4	1631	COO^- modes
5	1078	Out of plane bending mode of -CH
6	604	Asymmetric strectching vibrational frequency of Ti-O-Ti

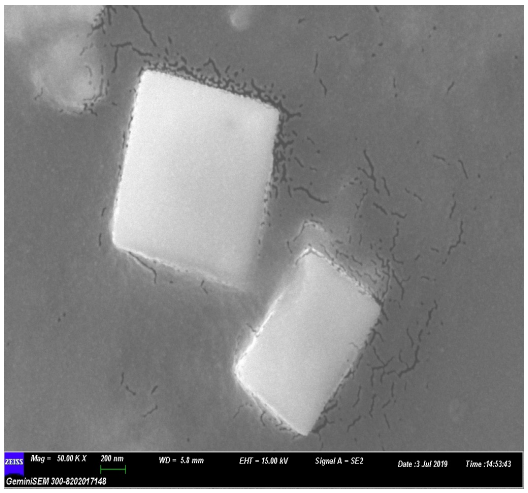

Figure S5. SEM imges of PNC shows the cubic morphology of perovskite nanocrystals at a scale bar of 200 nm.

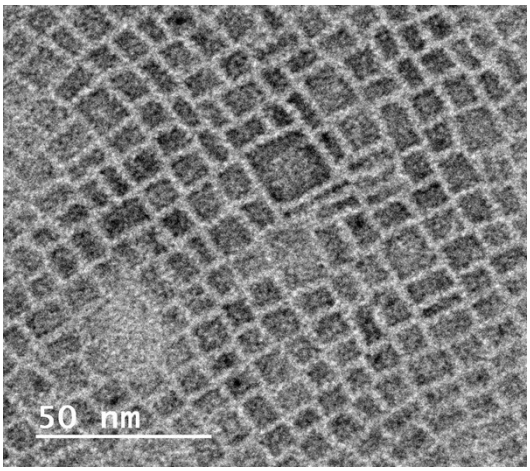

Figure S6. TEM images of PNC shows the cubic morphology of perovskite nanocrystals at a scale bar of 50 nm.

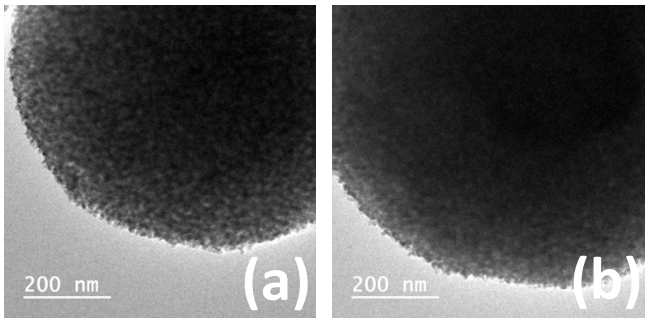

Figure S7. Magnified TEM images of (a) m-TiO_2 (b) PNC-Tm depicted the pores are densly interconnected as microcrystalline spheres at a scale bar of 200 nm.

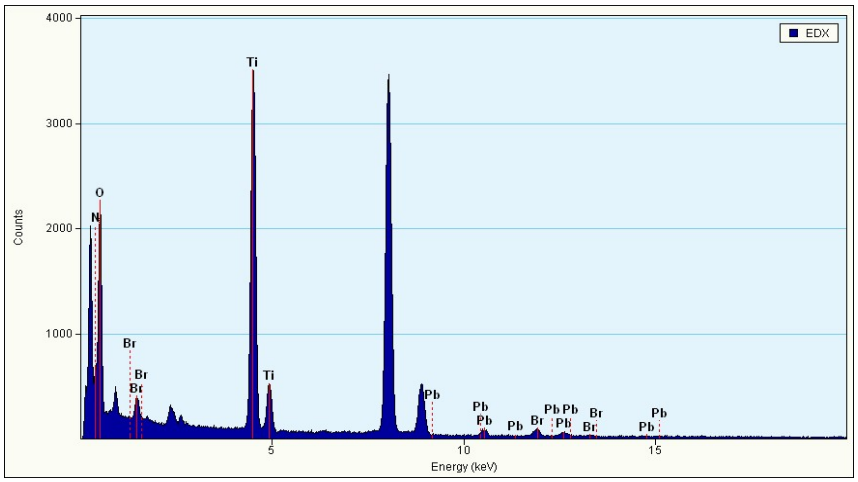

Figure S8. Shows the EDX and composition table of PNC-Tm with 1:3 of Pb and Br of $MAPbBr_3$ in pores of TiO_2 microspheres indicating the capping ligand don't affect the stiochiometry ratio of $MAPbBr_3$.

Element	Weight %	Atomic %	Uncert. %	Detector Correction	K-Factor
N (K)	9.82	19.87	0.27	0.28	3.466
O (K)	25.37	44.95	0.29	0.51	1.889
Ti (K)	55.38	32.78	0.32	0.98	1.227
Br (K)	5.04	1.79	0.11	0.99	2.575
Pb (L)	4.34	0.59	0.12	0.99	4.668

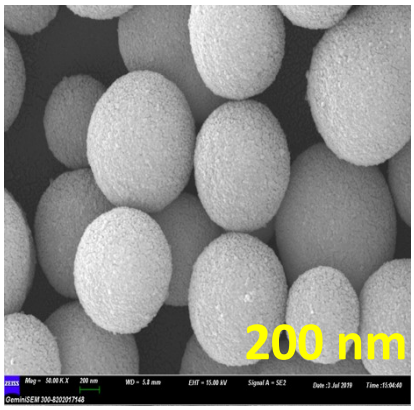

Figure S9. Shows the SEM images of TiO_2 microspheres at a scale bar of 200 nm.

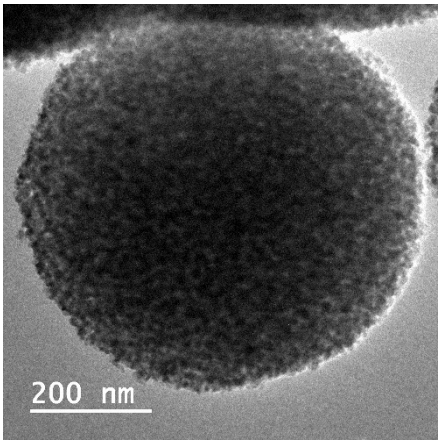

Figure S10. Shows the TEM images of TiO_2 microspheres at a scale bar of 200 nm.

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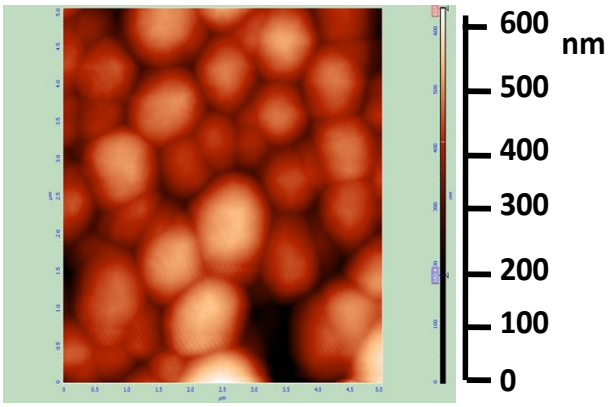


Figure S11. AFM image of TiO_2 microspheres with a Root Mean Square (RMS) value of 66.79 nm over an area of 25 μm^2.

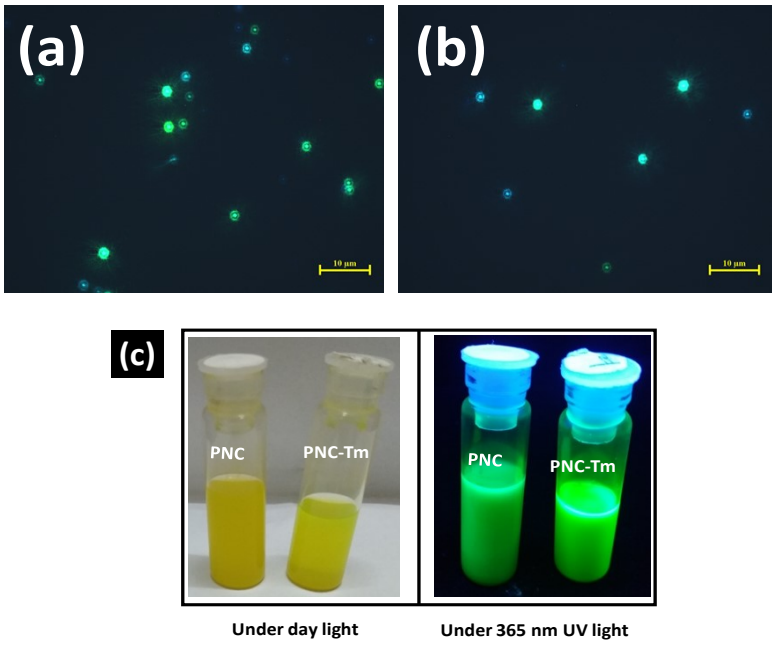
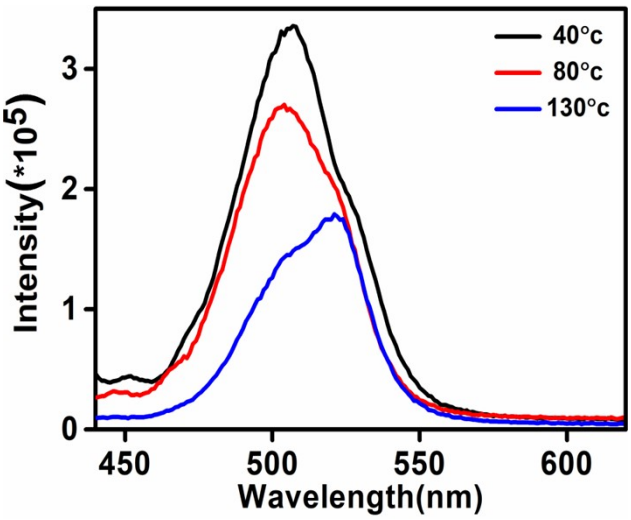


Figure S12. (a) and (b) Shows the fluorescent images of PNC-Tm at a scale bar of 10 µm indicating the TiO_2 microspheres is fluorescent after encapsulation with $MAPbBr_3$ perovskite. (c) images of PNC and PNC-Tm in day light and under 365 nm UV light.



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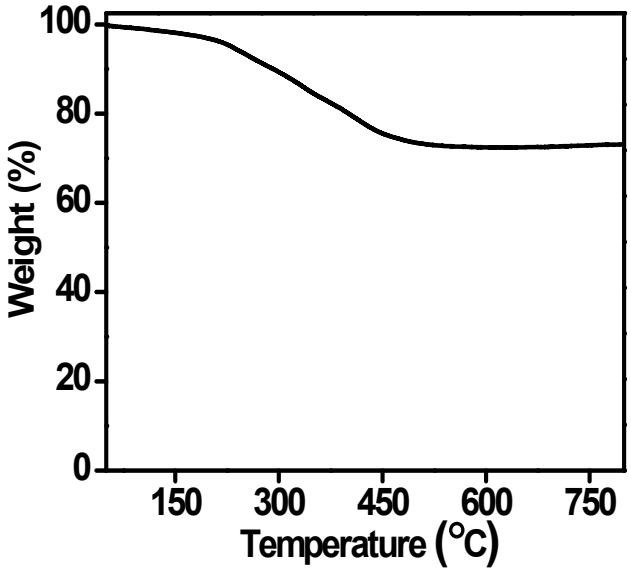

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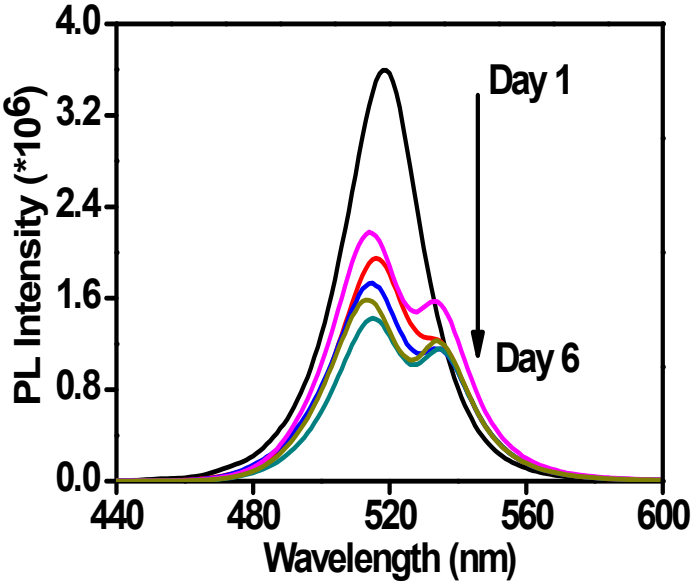

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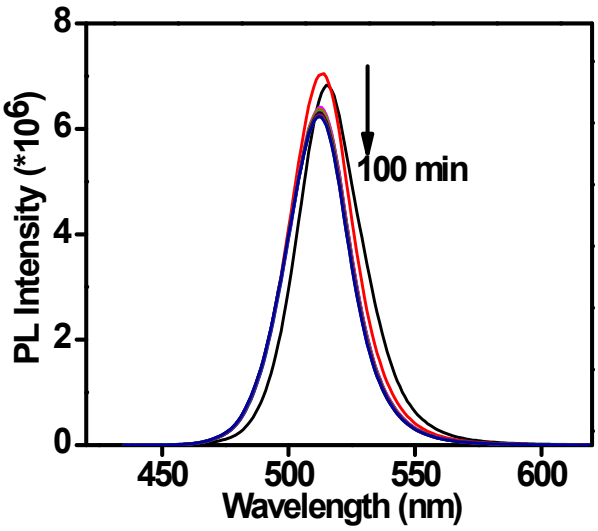

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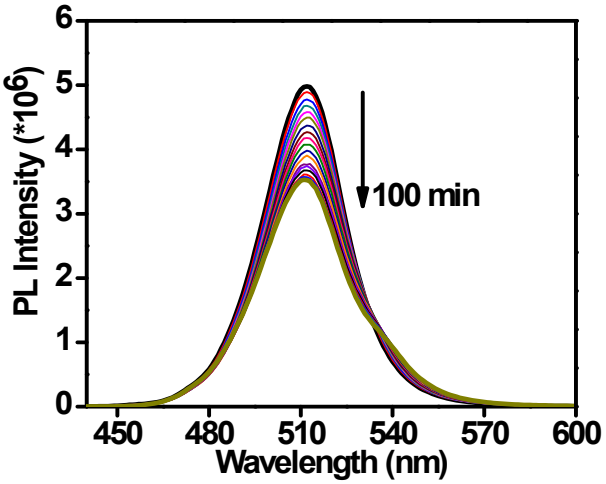

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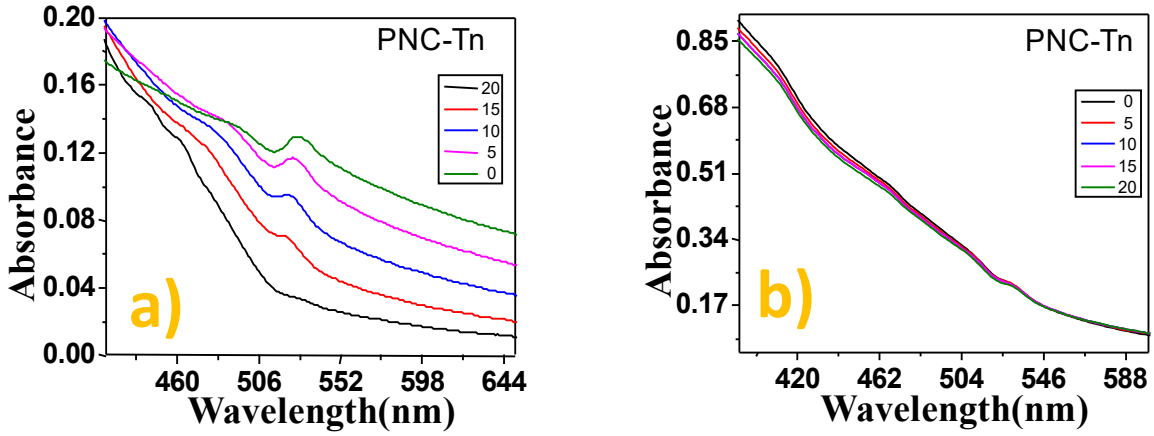

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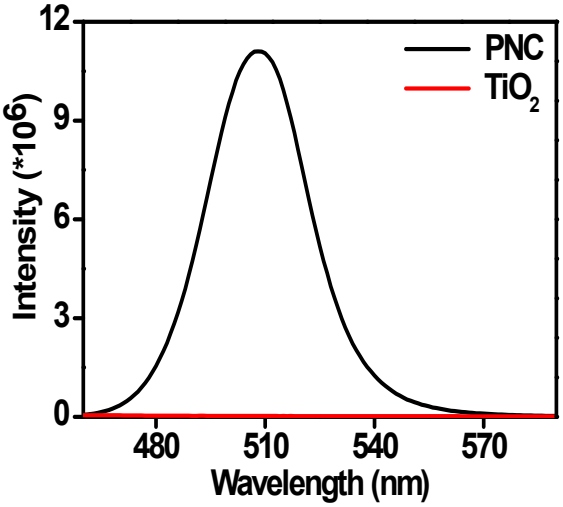

Figure S19. Photoluminescence (PL) spectra of $MAPbBr_3$ perovskite nanocrystals (PNC) and TiO_2 microspheres after separating from TiO_2 microspheres encapsulated with perovskites nanocrystals (T-PNC).

TiO_2 can be separated from the T-PNC at room temperature by sedimentation process and TiO_2 can be reusable after washing with ethanol followed by centrifugation. After that, PL spectra of TiO_2 has been taken, which shows the no fluorescence

PNC-Tm	PNC	PNC-Tn
E_{LUMO} = -e (E_{red} + 4.4) = - (-0.82 + 4.4) = - 3.56 eV E_{HOMO} = E_{LUMO} - E_g = -3.56-2.26 = -5.82 eV	E_{LUMO} = -e (E_{red} + 4.4) = - (-0.83 + 4.4) = - 3.57 eV E_{HOMO} = E_{LUMO} - E_g = -3.57-2.43 = -6.00 eV	E_{LUMO} = -e (E_{red} + 4.4) = - (-0.71 + 4.4) = - 3.69 eV E_{HOMO} = E_{LUMO} - E_g = -3.69-2.31 = -6.00 eV

Table S2. Calculation of lowest unoccupied molecular orbital (LUMO) and highest occupied molecular orbital (HOMO) value of PNC-Tm, PNC and PNC-Tn.