# Supplymentary Information

## Succinic acid assisted stability enhancement of colloidal organometal halide perovskite and its application as a fluorescent keypad lock

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**Contents**

## 1. Material characterization

**1.1 UV Vis Absorption Spectroscopy and Photoluminescence Spectroscopy** Shimadzu UV-Vis 2450 spectrophotometer was used for recording UV-Vis absorption spectra in the range of 200-650 nm. Photoluminescence spectra were taken by Horiba scientific Fluoromax-4C spectrophotometer. A quartz cuvette of 10 mm path length and volume 3 ml was used for collecting the spectra.

**1.2. TCSPC studies** Fluorescence lifetime decay measurements were recorded on 1cm quartz cell on a Horiba Jobin Yvon ," Fluorocube Fluorescence Lifetime System" equipped with NanoLEDs and LDs as the excitation source and an automated polarization accessory (Model 5000 U-02).

**1.3 Fourier Transform Infrared Spectroscopy (FTIR)** Infra red spectra (IR) of material were recorded by using Thermo scientific Nicolet 6700. The use of the spectral subtraction provided reliable and reproducible results.

**1.4 X-Ray Photoelectron Spectroscopy (XPS)** Thin film of perovskites has been studied on XPS with model no. PHI 5000 VersaProbe III for urface analysis.

**1.5 Transmission Electron Microscopy** (TEM) TEM study was carried out by TEM TECHNAI G2 20 S-TWIN. A drop (5-10µL) of diluted samples was placed on Carbon coated Copper grid. Again a drop was added before drying it. Afterwards drying was carried at ambient temperature.

**1.6 Powder XRD** was carried out on Bruker -D8 Advance having Target Cu and accelerating voltage 40kV from 5 to 50˚ at the rate of 2˚/min. Thin film samples were prepared on silica glass.

**1.7 FE-SEM (Carl Zeiss)** has been formed to know about the surface morphology of thin film of perovskite on glass slide at 20 kV.

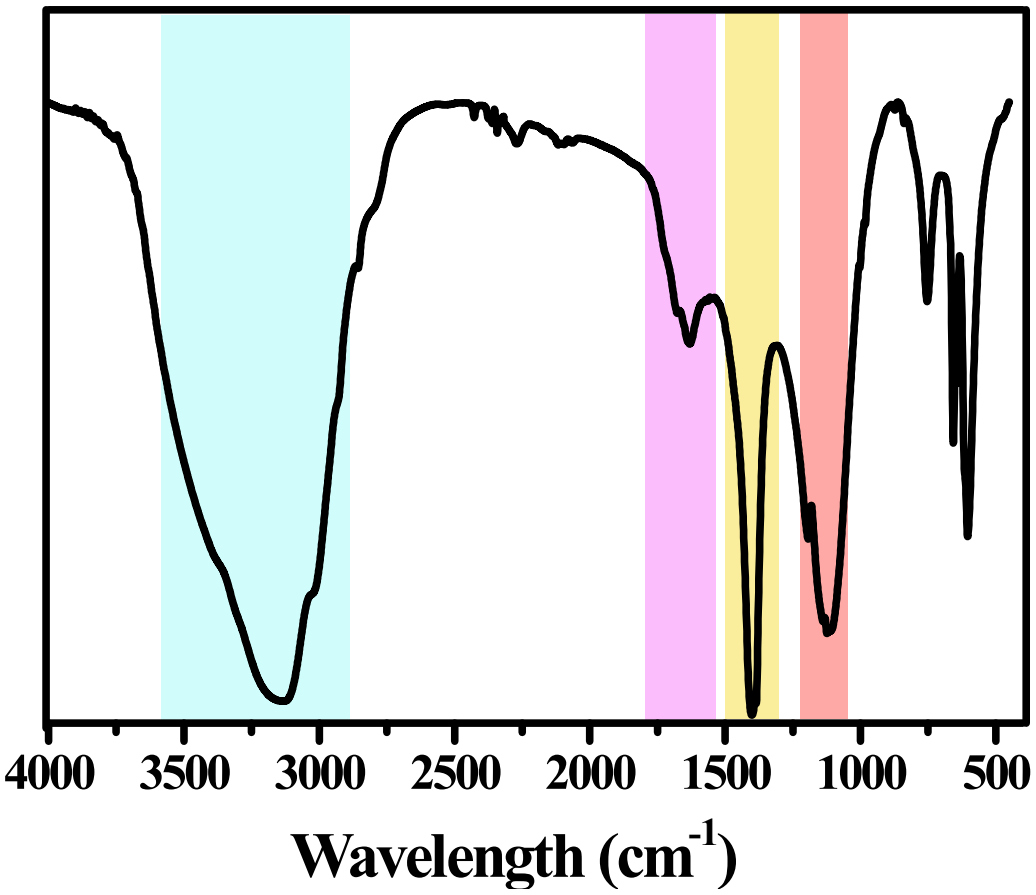


**Figure S1. FT-IR spectra of $MAPbBr_3$ solution**

**Table S1 summarizes solved Powder XRD pattern for $MAPbBr_3$ Perovskite solution**

| 2Θ | Θ | sinΘ | 2sinΘ | $Sin^2Θ$ | Ratio | d | (hkl) |
|---|---|---|---|---|---|---|---|
| 14.97 | 7.49 | 0.130 | 0.261 | 0.017 | 1 | 5.93 | (100) |
| 21.16 | 10.58 | 0.183 | 0.367 | 0.034 | 1.99 | 4.19 | (110) |
| 26.94 | 13.47 | 0.232 | 0.464 | 0.054 | 3.08 | 3.32 | (111) |
| 30.17 | 15.08 | 0.260 | 0.520 | 0.068 | 4 | 2.96 | (200) |
| 34.07 | 17.03 | 0.292 | 0.584 | 0.085 | 5.04 | 2.63 | (210) |
| 37.16 | 18.58 | 0.318 | 0.636 | 0.101 | 5.99 | 2.42 | (211) |
| 43.09 | 21.55 | 0.367 | 0.734 | 0.135 | 7.97 | 2.09 | (220) |
| 45.91 | 22.96 | 0.390 | 0.780 | 0.152 | 9 | 1.97 | (300) |

**S2**

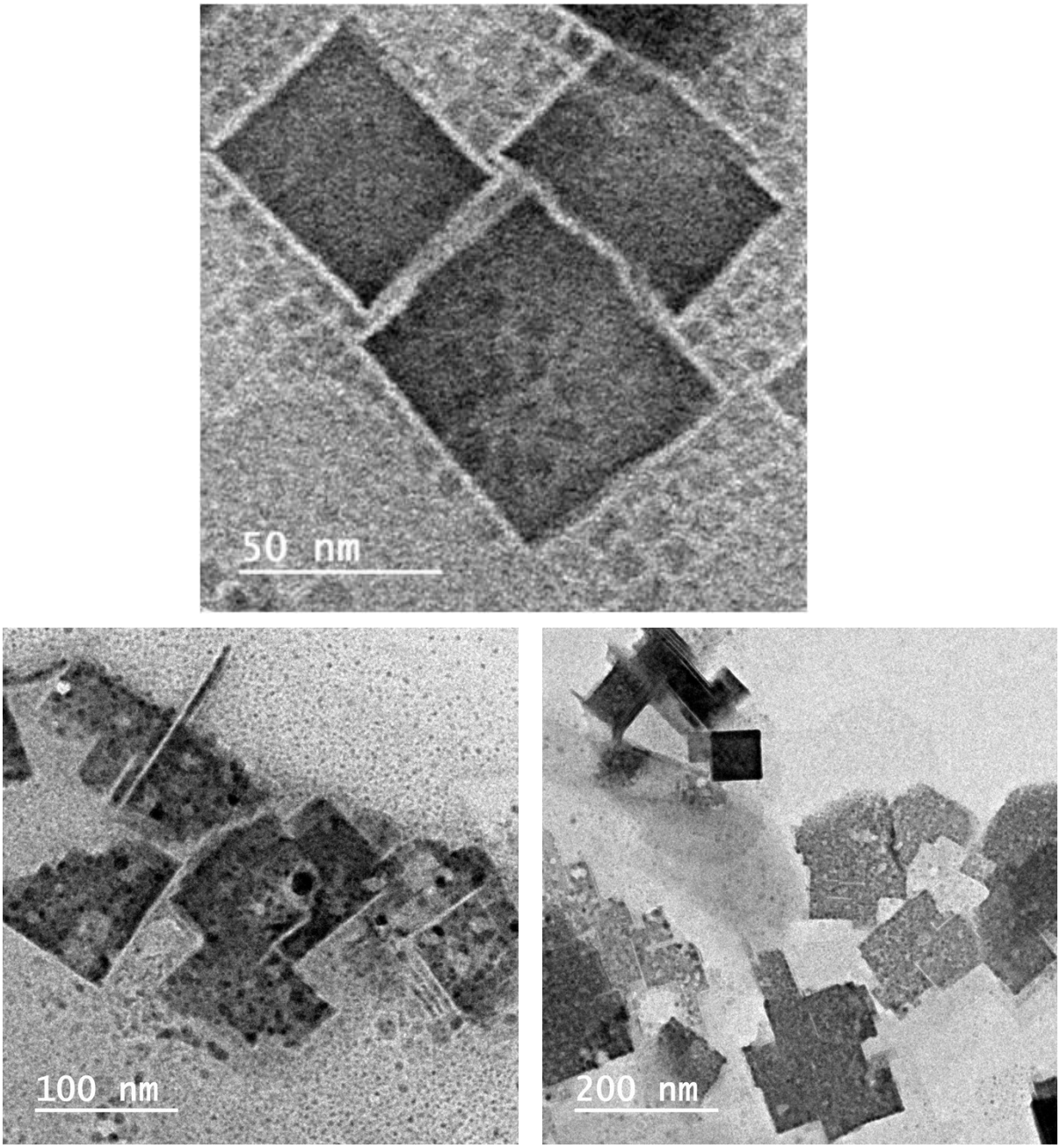


**Figure S2 shows TEM images in different scales at 200kV**

**S3**

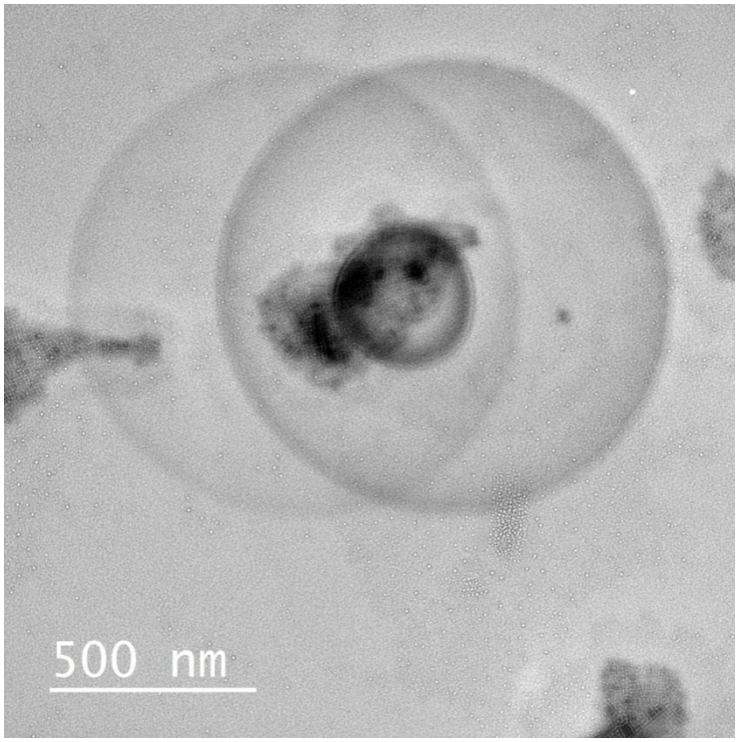


**Figure S3 Degraded TEM image after 25 minutes**

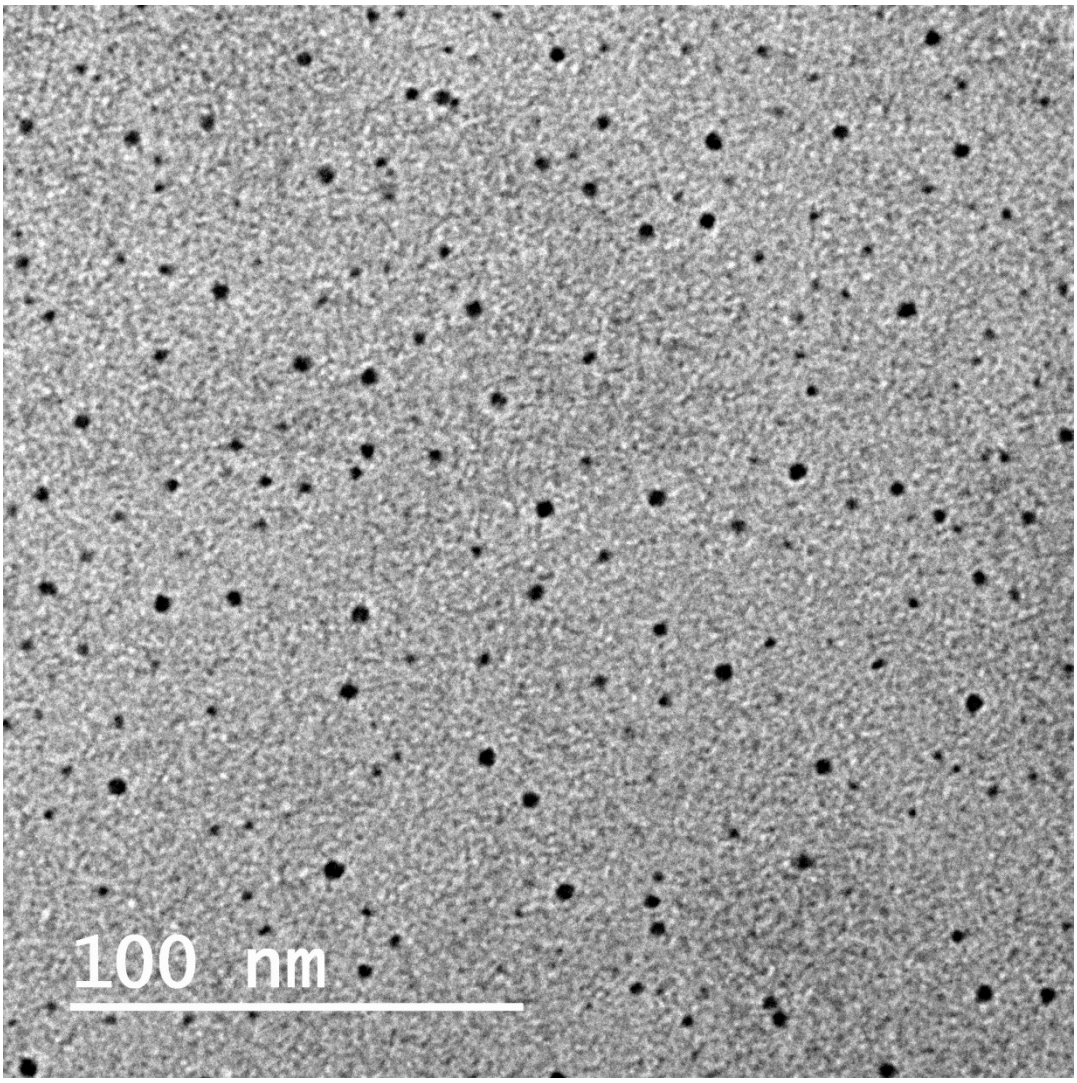


**Figure S4 shows TEM image of MAPbBr3 using Oleic and oleylamine (100/200µl) in $CHCl_3$**

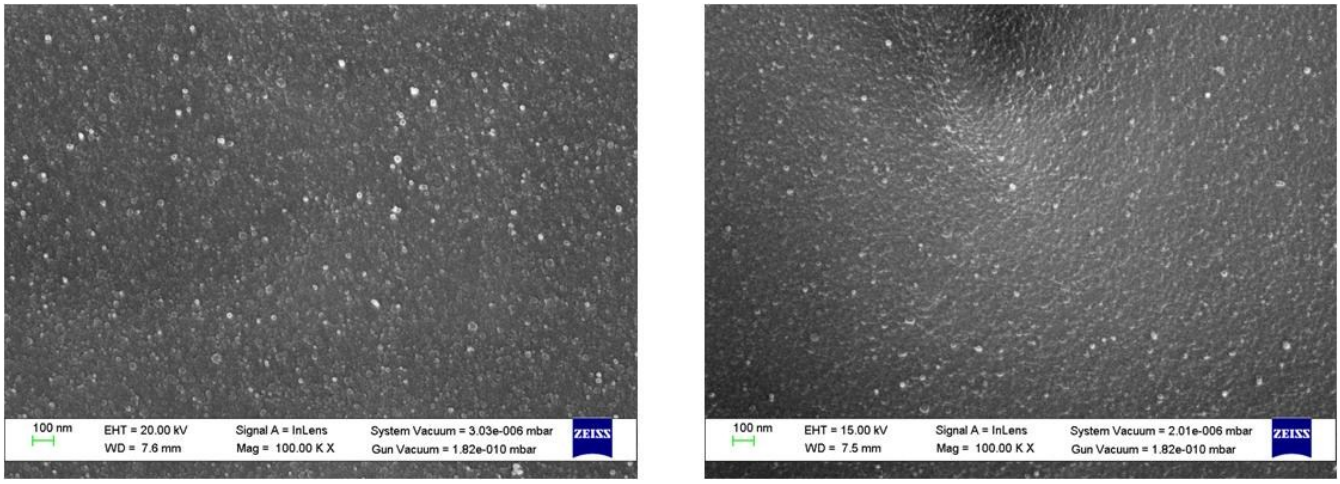


**Figure S5 FE SEM (Carl Zeiss) images for $MAPbBr_3$ solution (using succinic acid) in $CHCl_3$ and Toluene**

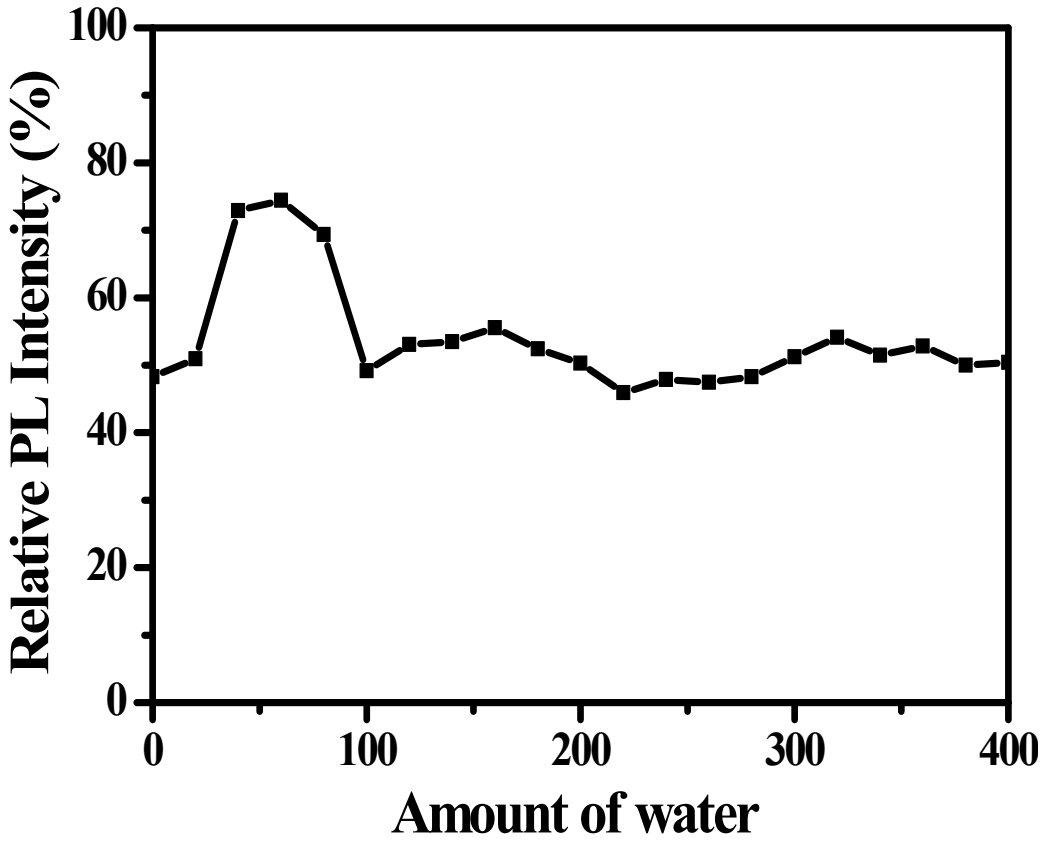


**Figure S6 Relative PL intensity versus amount of water.**

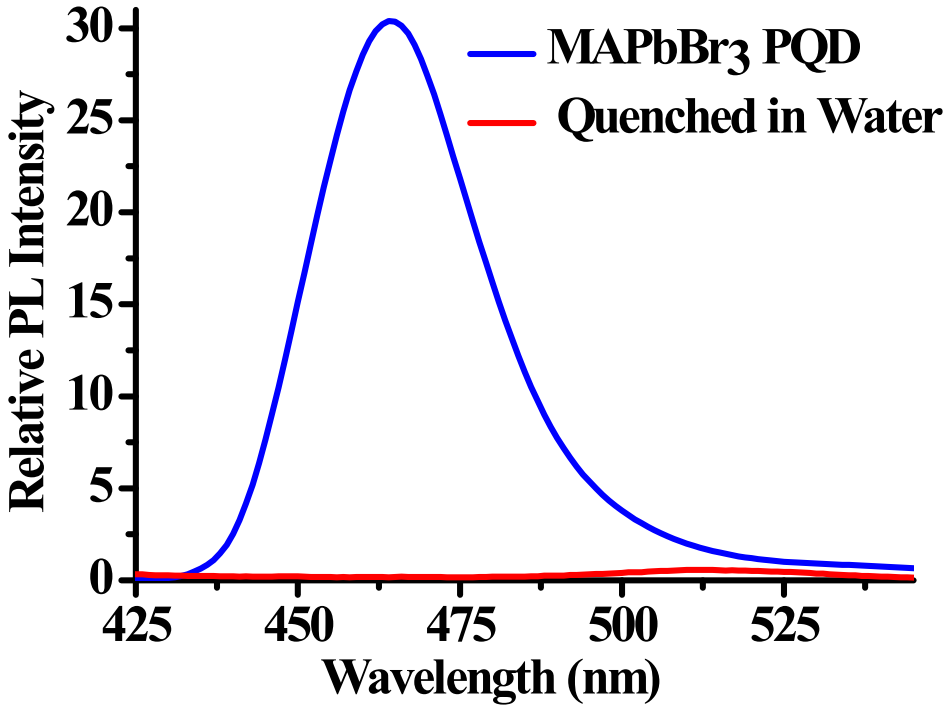


**Figure S7 Quenching of $MAPbBr_3$ solution (synthesized using oleic acid )in small amount of water**

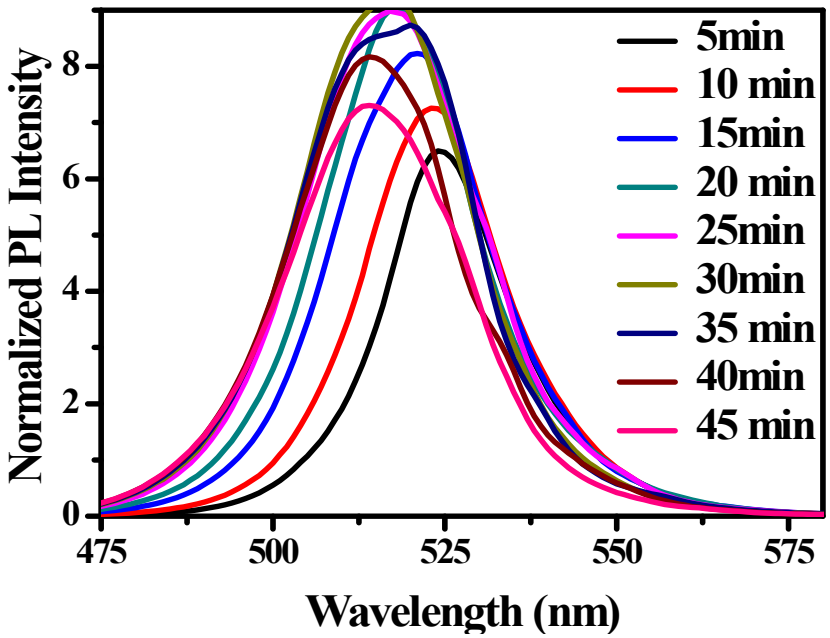


**Figure S8 shows shifted time dependent PL studies of perovskite solution in the presence of 400µL of water**

**S9**

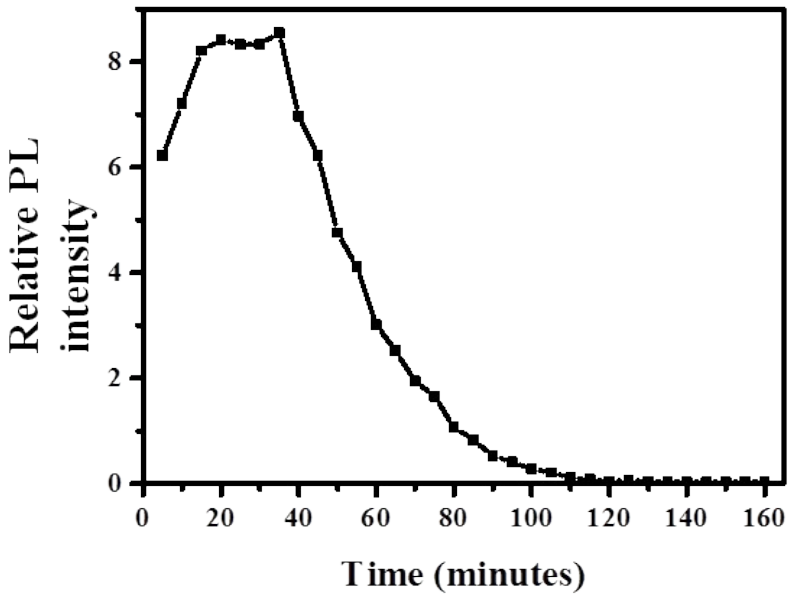


**Figure S9 shows decreasing relative PL intensity and degradation of perovskite solution in 150 minutes in the presence of water**

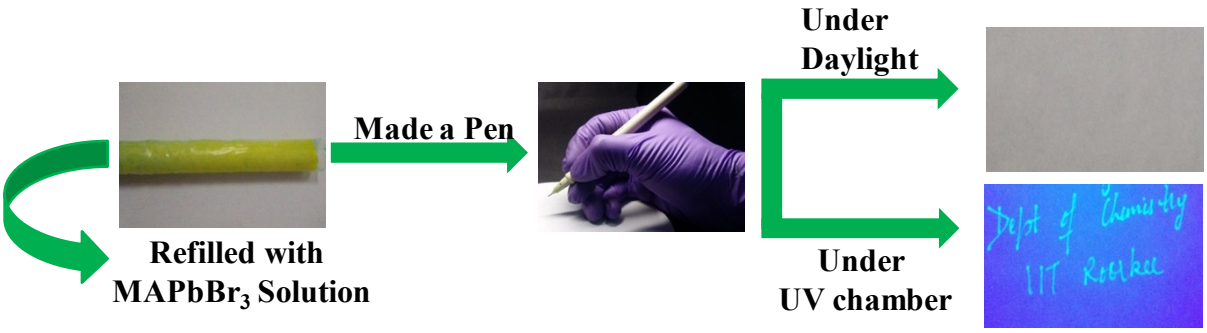


**Figure S10 refilling of pen and application as fluorescent ink**