Supporting Information

Ultrastable Luminescent Organic-Inorganic Perovskite Quantum Dots via Surface Engineering: Coordination of Methylammonium Bromide and Covalent Silica Encapsulation

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1. **XRD Characterization of SMAPB-QDs powder**

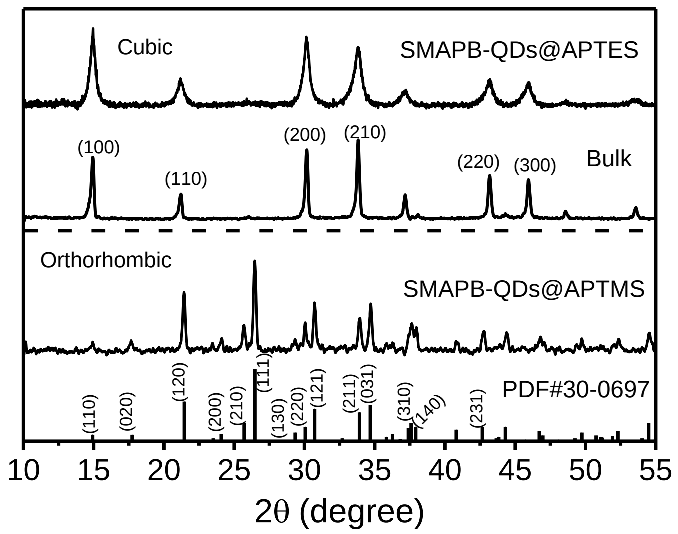

Figure S1. XRD patterns of cubic and orthorhombic SMAPB-QDs prepared with the assistance of APTES and APTMS, respectively. Bulk $CH_3NH_3PbBr_3$ gives a cubic phase, and the reference lines in the bottom are from JCPDS# 30-0697.

2. Optimization of doping ratio of SMAPB-QDs powder in the composite

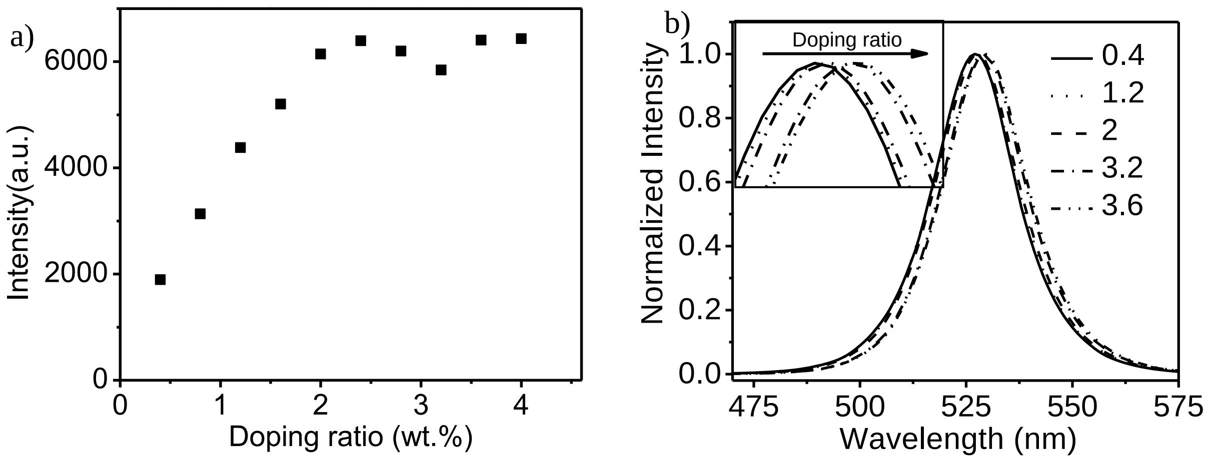

Figure S2. (a) PL intensity SMAPB-QDs/SiO_2 composite versus the doping ratio of QDs. The weight ratio of SMAPB-QDs to silica matrix is 0.4, 0.8, 1.2, 1.6, 2, 2.4, 2.8, 3.2, 3.6 and 4%, respectively. The scatters were the integral of green emissions upon the 405-nm excitation. (b) Normalized emission spectra of the composite powder with different doping ratios. The inset shows the enlarged part of emission peaks.

From Figure S2a it can be seen that PL intensity of SMAPB-QDs/SiO_2 composite powder reaches its maximum value at around 2 wt.%. Higher doping ratio does not evidently increase the PL intensity, mostly because of concentration quenching. On the other hand, however, too many SMAPB-QDs/SiO_2 powders may influence the quality of as-prepared silica gel. Therefore, 2% doping ratio is chosen as the optimal one for the following experiments. With the increase of doping ratios, red-shift of the green emission can be observed clearly in Figure S2b.

3. HAADF-STEM images of SMAPB-QDs/SiO_2 composite powder and size distribution

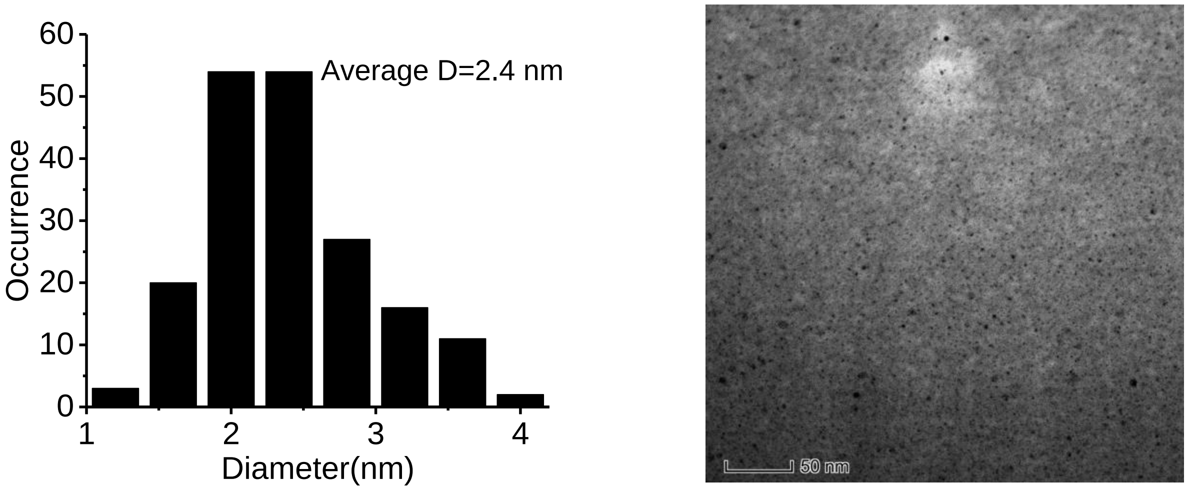

Figure S3. Histogram of particle size of SMAPB-QDs in the silica composite (left). The data are counted from the HAADF-STEM image (right).

4. Photostability of SMAPB-QDs/SiO_2 composite powder

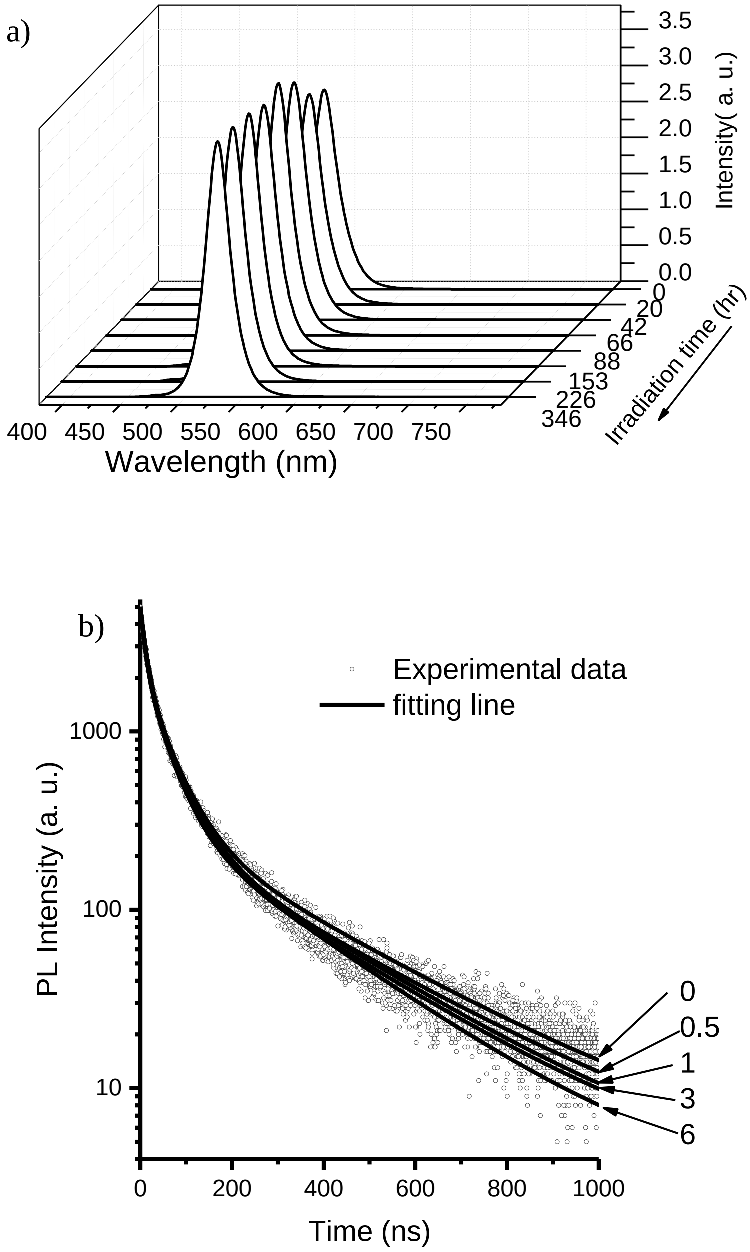

Figure S4. (a) PL emission spectra and (b) time-resolved PL decays of SMAPB-QDs/SiO_2 composite powder under the illumination of a 450-nm light (60 mW/cm^2) for different times (N_2-protected). In (a) the spectra were measure at the time of 0, 20, 42, 66, 88, 153, 226 and 346 h, respectively. In (b) the monitored wavelengths are fixed at their respective emission peaks (λ_{ex}=405 nm), and measured at the time of 0, 0.5, 1, 3 and 6 h. The data are fitted with a tri-exponential function (solid lines).

5. Stability of SMAPB-QDs/SiO_2 composite powder in blue LED device

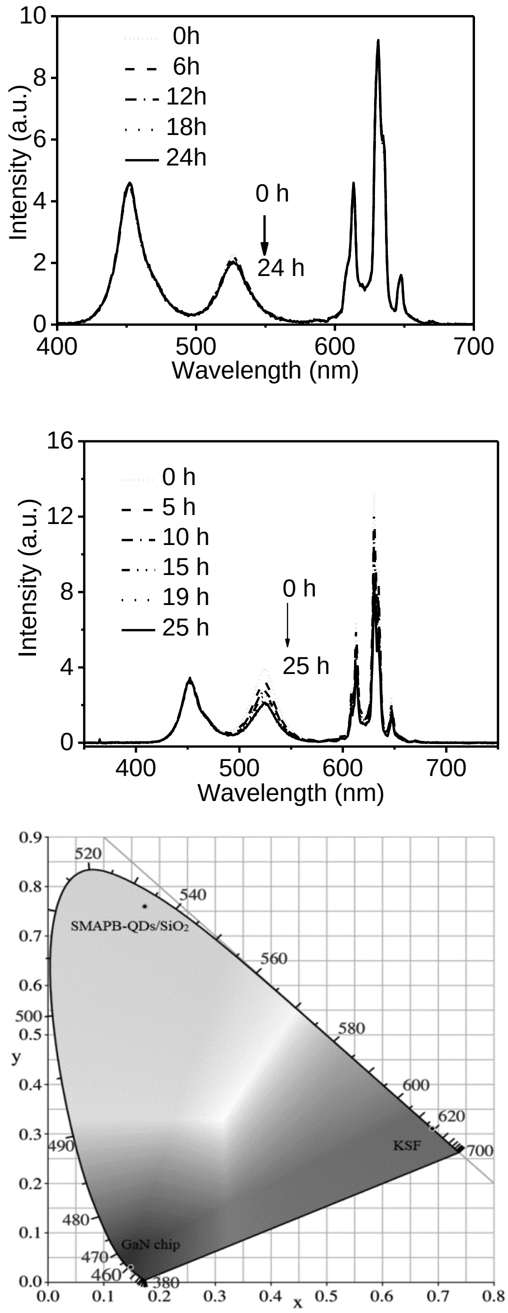

Figure S5. Time-dependent electroluminescence spectra of SMAPB-QDs/SiO_2 composite powder (upper) and primary SMAPB-QDs (middle) in blue LED device. The powders were encapsulated by PMMA film and put onto the surface of LD chip. The blue, green and red emissions were attributed to blue-chip, perovskite QDs and KSF, respectively. The LED devices worked under a voltage of 3 V and a driving current of 20 mA (RH of 60%), and the spectra were measured at different times as indicated in the figure. The bottom is CIE coordinate of SMAPB-QDs/SiO_2 composite powder-based LED device, as well as that of constituent blue LED, SMAPB-QDs/SiO_2 and KSF.

6. Fitting results of PL decays of SMAPB-QDs/SiO_2 composite powder

PL decay of primary SMAPB-QDs and SMAPB-QDs/SiO_2 composite treated with different amount of MABr are, respectively, fitted by a biexponential and tri-exponential function, as described in the maintext. The resultant parameters are listed in Table S1.

Table S1. Fitting parameters of PL decays of SMAPB-QDs/SiO_2 composite

Samples treated with different MABr/mM	A_1	τ_r /ns	A_2	τ_{nr} /ns	A_3	τ_{ET} /ns	τ_{ave} /ns	R^2
Primary (0)	0.96	8	0.09	29.5	0	0	10.335	0.999
2.3	0.48	8	0.44	25.9	0.08	95	22.836	0.9997
4.6	0.46	9.8	0.42	35.7	0.12	145.8	36.998	0.9996
6.9	0.44	7.8	0.42	34.7	0.14	183.8	43.738	0.9994
11.5	0.48	10.4	0.4	39.4	0.13	174.3	43.411	0.9995
23	0.44	9.5	0.43	36.6	0.14	163.3	42.78	0.9996
46	0.44	9.6	0.42	36.5	0.14	160	41.954	0.9996
69	0.52	11.7	0.4	38.4	0.09	132.1	33.333	0.9996