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Highly efficient solid-state mesoscopic PbS embedding CuS quantum dot-sensitized solar cells

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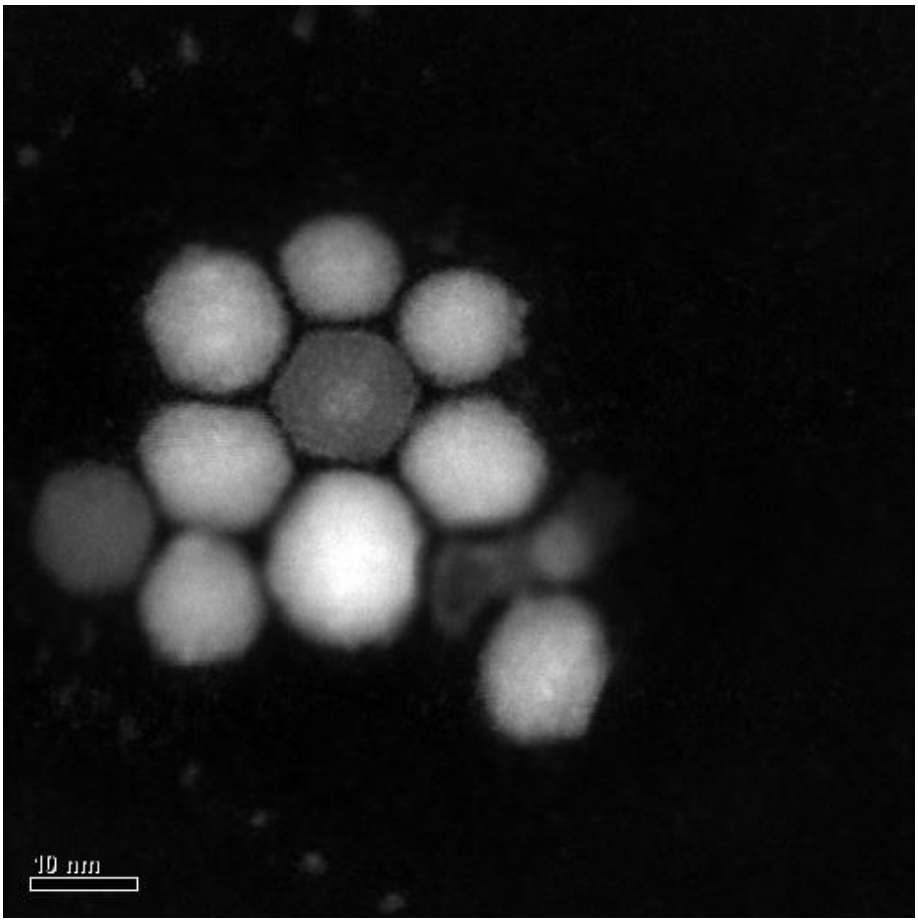
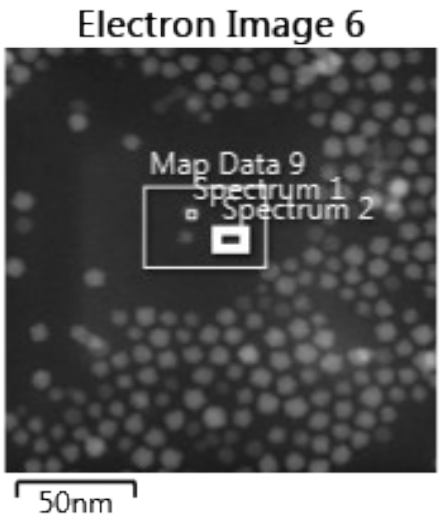
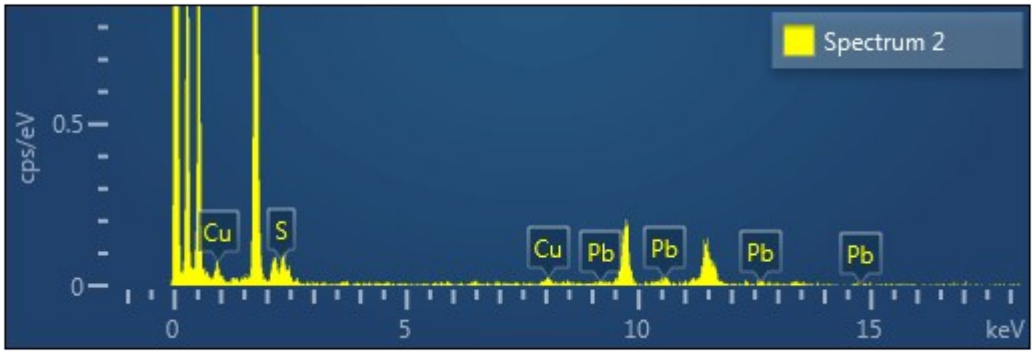


S1. STEM image of PbS[CuS] (Cu:S = 2:1 sample).

Forming hexagonal - shaped CuS nanoparticles



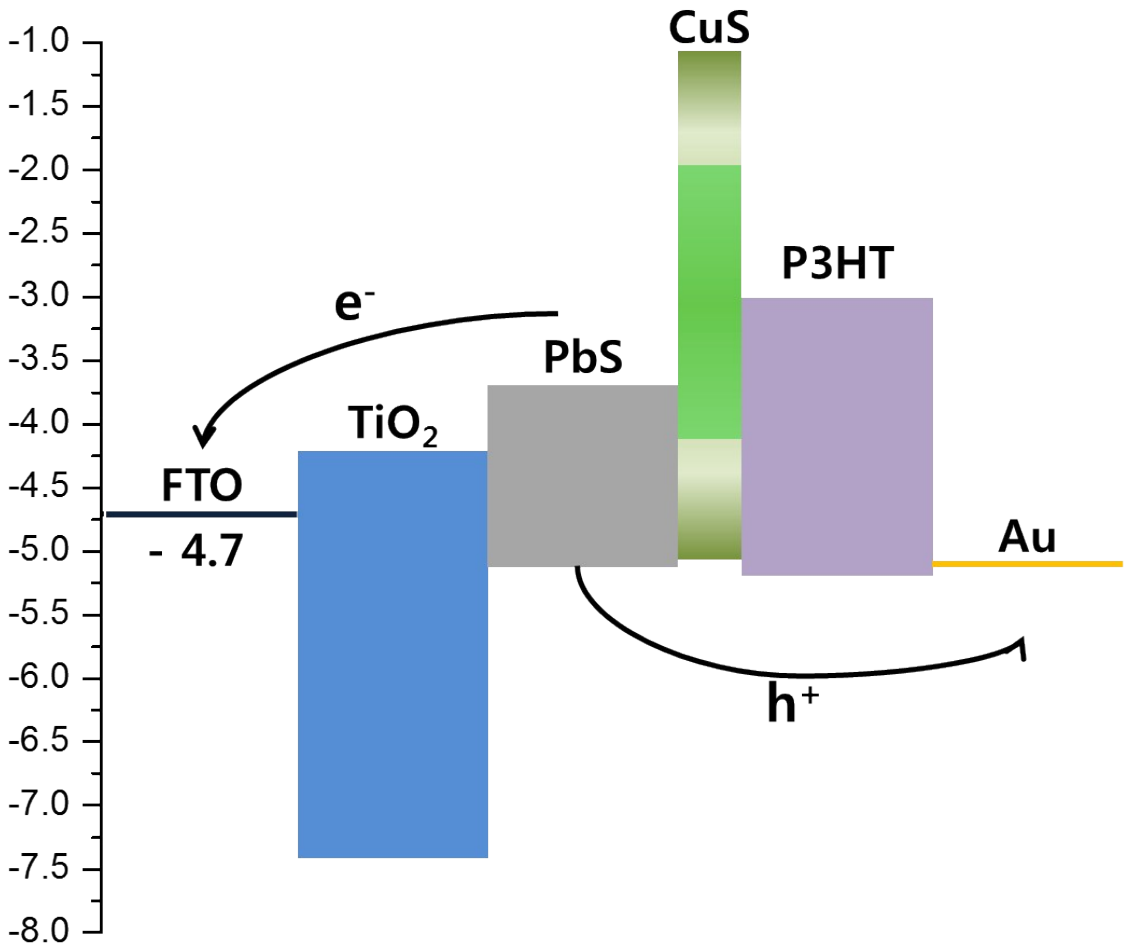


Element	Line Type	k factor	Absorption Correction	Wt%	Wt% Sigma	Atomic %
S	K series	0.98041	1.00	15.59	7.41	46.59
Cu	K series	1.42103	1.00	13.75	6.25	20.74
Pb	L series	3.10728	1.00	70.66	9.53	32.68
Total:				100.00		100.00

S2. EDX data of PbS[CuS] QDs (Cu:S = 0.5:1)

	Cu		Pb		mol ratio
	ppm	mol	ppm	mol	
6.25%	6.307	0.099	125.1	0.603	1:60.9
12.5%	13.02	0.205	125.5	0.606	1:2.96
25%	18.82	0.296	84.04	0.406	1:1.37

S3. ICP data of PbS[CuS] QDs (Cu:S = 0.5:1)



S4. Schematic band offsets of PbS/CuS QDSSc

Cell Fabrications

Mesoporous TiO_2 (m-TiO_2) electron conductor with ~ 500 nm-thickness was deposited on a blocking TiO_2 (~ 50 nm in thickness)/fluorine-doped tin oxide (FTO) glass (TEC 7, Pilkington) by spin coating and subsequent calcination at 450 ^oC for 1h under air condition. The QDs and molecular linker were deposited sequentially by spin coating. MPA (1% in EtOH) was spin coated at 3000rpm for 30s, washed with acetone and chloroform. PbS/CuS (0.1ml 15 mg/mL in hexane/chlorobenzene (10/1 vol%)) and EDT (1% in EtOH) were sequentially spin coated at 3000 rpm for 30s. Active layer (QD + EDT) deposition was repeated twenty times. poly-3-hexylthiophene (P3HT) were deposited on active layer by spin coating in same manner. Finally, the gold counter electrode with 50 ~ 60nm-thickness was deposited by thermal evaporation.

The solar cell device was kept under ambient condition (room temperature and air) for stability test. Cell efficiency was obtained after one and two day.