Supporting information

Platinum-Free Counter Electrode Comprised of Metal-Organic-Frameworks (MOFs)-Derived Cobalt Sulfide Nanoparticles for Efficient Dye-Sensitized Solar Cells (DSSCs)

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1 Chemicals

Cobalt(II) chloride hexahydrate ($CoCl_2 \cdot 6H_2O$, >98%), 2-methylimidazole (mIm, 99%), Hexadecyltrimethylammonium bromide (99%), Ethanol (EtOH, 99.5%), isopropyl alcohol (IPA, 99.5%), titanium (IV) tetraisoproproxide (TTIP, >98%), lithium perchlorate (LiClO4, ≥98.0%), and 2-methoxyethanol were obtained from Sigma Aldrich. Lithium iodide (LiI, synthetical grade), iodine (I_2, synthetical grade) and poly (ethylene glycol) (PEG, MW~20,000) were obtained from Merck. Cis-diisothiocyanato bis-(2,2'-bipyridyl-4,4'-dicarboxylato) ruthenium (II) bis(tetrabutylammonium) (N719 dye), transparent TiO_2 paste (TL paste, Ti–nanoxide HT/SP, 13 nm), and Surlyn® (SX1170–60, 60 μm) were obtained from Solaronix (S.A., Aubonne, Switzerland). 1,2-Dimethyl-3-propylimidazolium iodide (DMPII) was obtained from Tokyo Chemical Industry Co., Ltd. Acetonitrile (ACN, 99.99%), nitric acid (HNO_3, ca. 65% solution in water) was obtained from J. T. Baker. Acetone (99%), 4-tert-butylpyridine (tBP, 96%), and tert-butyl alcohol (tBA, 96%) were obtained from Acros. 3-methoxypropionitrile (MPN, 99%) was obtained from Alfa Aesar. Commercial light scattering TiO_2 particles, ST-41 (200 nm), were obtained from Ishihara Sangyo, Ltd.

2 Characterization of the synthesized samples

The morphology of the samples was observed with field-emission scanning electron microscopy (FE-SEM) (Nova NanoSEM 230, FEI, Oregon, USA) coupled with the energy dispersive X-ray spectroscopy (EDX, model 7021-H, Horiba). The crystallinity of the samples was examined with powder X-ray diffraction (XRD) patterns (Rigaku X-ray diffractometer with copper Kα radiation (λ = 1.5406 Å)) over angles from 20 to 80 degree. A scanning rate of 10 degree per minute was applied in all XRD experiments.

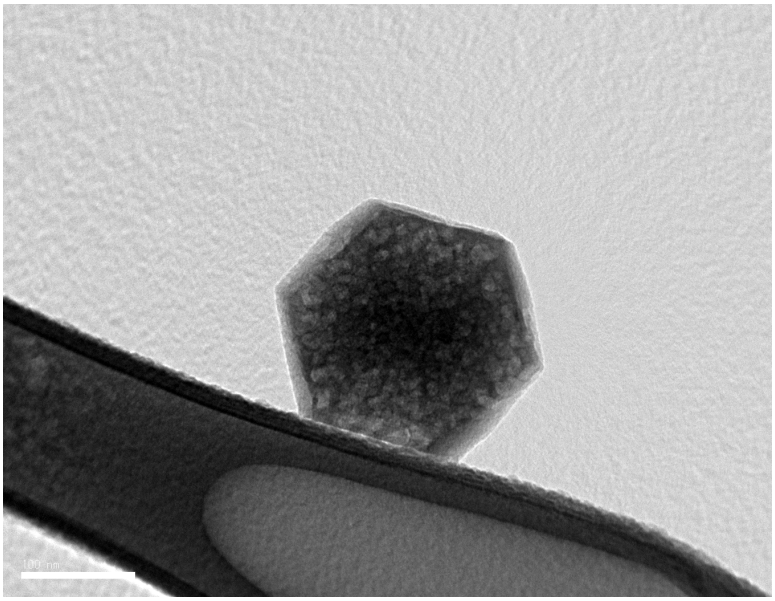

Fig S1. A typical TEM image of the synthesized ZIF-67 NPs. The scale bar is 100 nm.

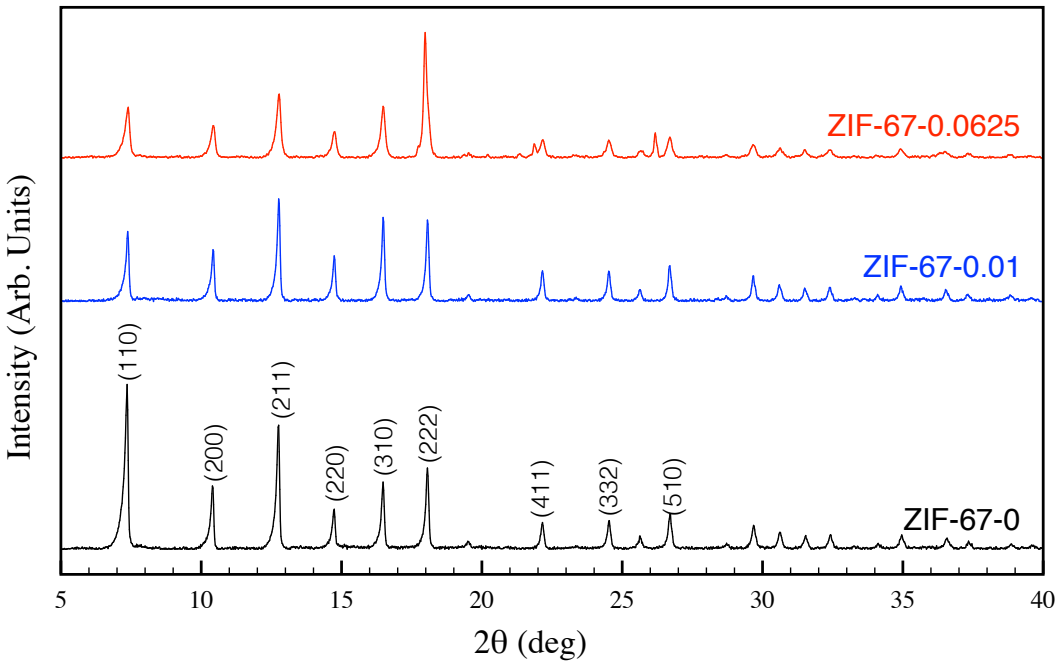

Fig S2. XRD patterns of ZIF-67 with addition of various amounts of CTABr.