Electronic Supplementary Material (ESI) for CrystEngComm.

Supporting Information

Copper Sulfide Nanoparticles with Potential Bifunctional Properties: Supercapacitors and Photocatalysis

Materials

Copper chloride ($CuCl_2$), sodium dodecyl benzene sulfonate (SDBS), sodium sulfide heptahydrate ($Na_2S{\cdot}7H_2O$), Ni foam, Carbon black, polytetrafluoro-ethylene (PTFE), potassium hydroxide (KOH), ethanol, sodium hydroxide (NaOH), sulphuric acid (H_2SO_4), 30% hydrogen peroxide (H_2O_2), absolute ethanol (C_2H_5OH), ethylene glycol (EG), methyl orange (MO). All the reagents in this experiment are analytically pure.

Characterization

The grain characteristics of the products were characterized by XRD. UV–vis spectra of the sample and MO solutions were recorded on a UV–vis spectrophotometer. The specific surface area and pore distribution were performed by BET method. The morphology of the samples were characterized by FESEM and TEM and HRTEM. TGA curves were performed in the temperature region 30-1000℃ with a heating rate of 10 ℃ min^{-1}.

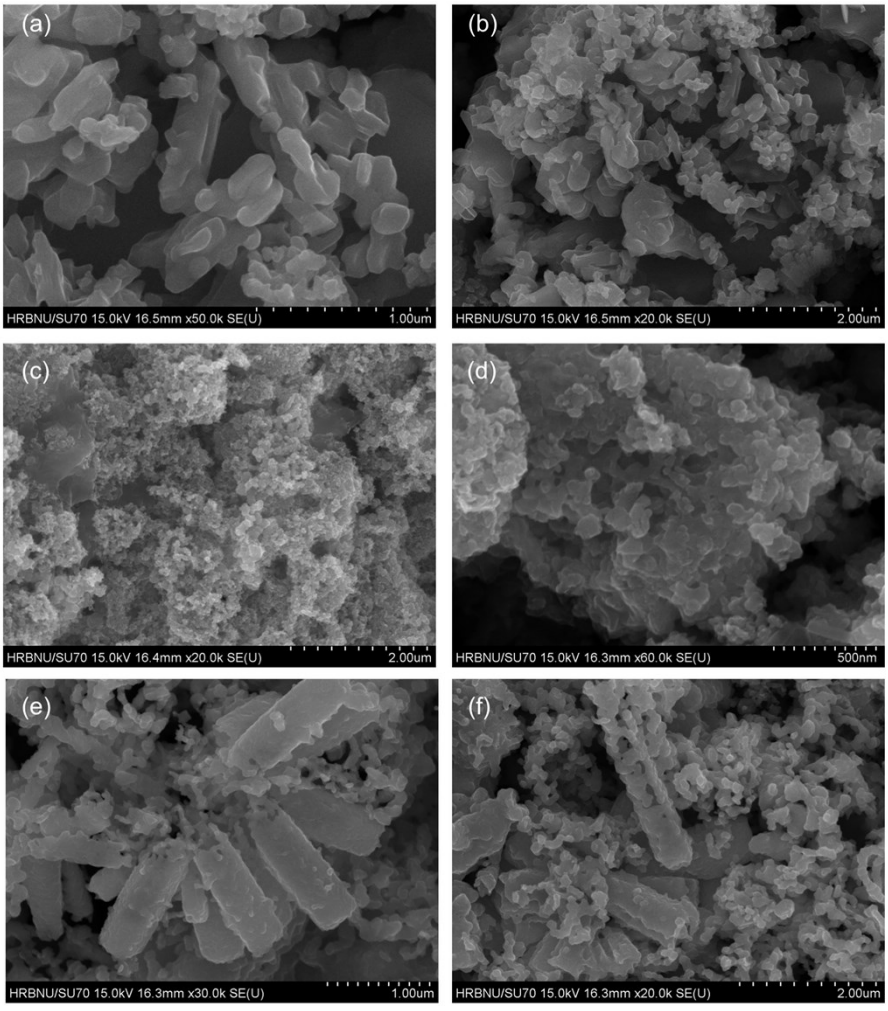

Fig. S1 SEM images of synthesized NP-1 (a, b), NP-2 (c, d) and NP-3 (e, f) materials.

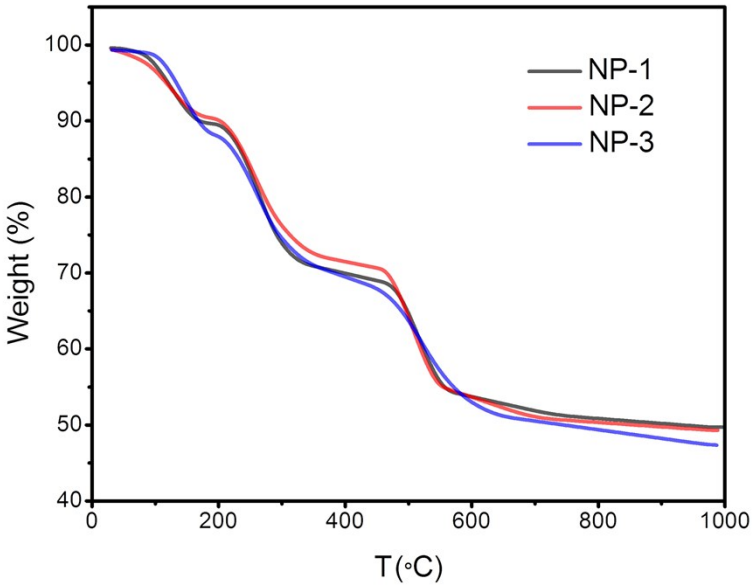

Fig. S2 The TGA curves of NPs.

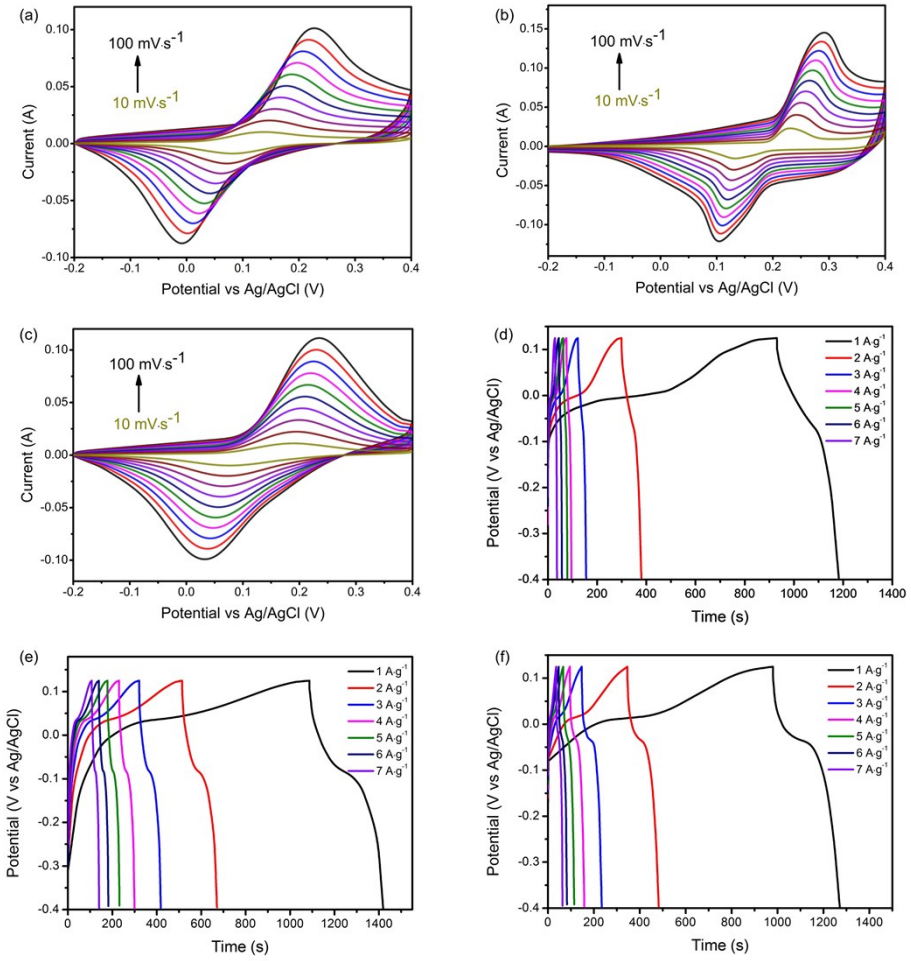

Fig. S3 Cyclic voltammetry curves of NP-1 (a), NP-2 (b) NP-3 (c) and GCD curves of as-prepared NP-1 (d), NP-2 (e) and NP-3 (f).

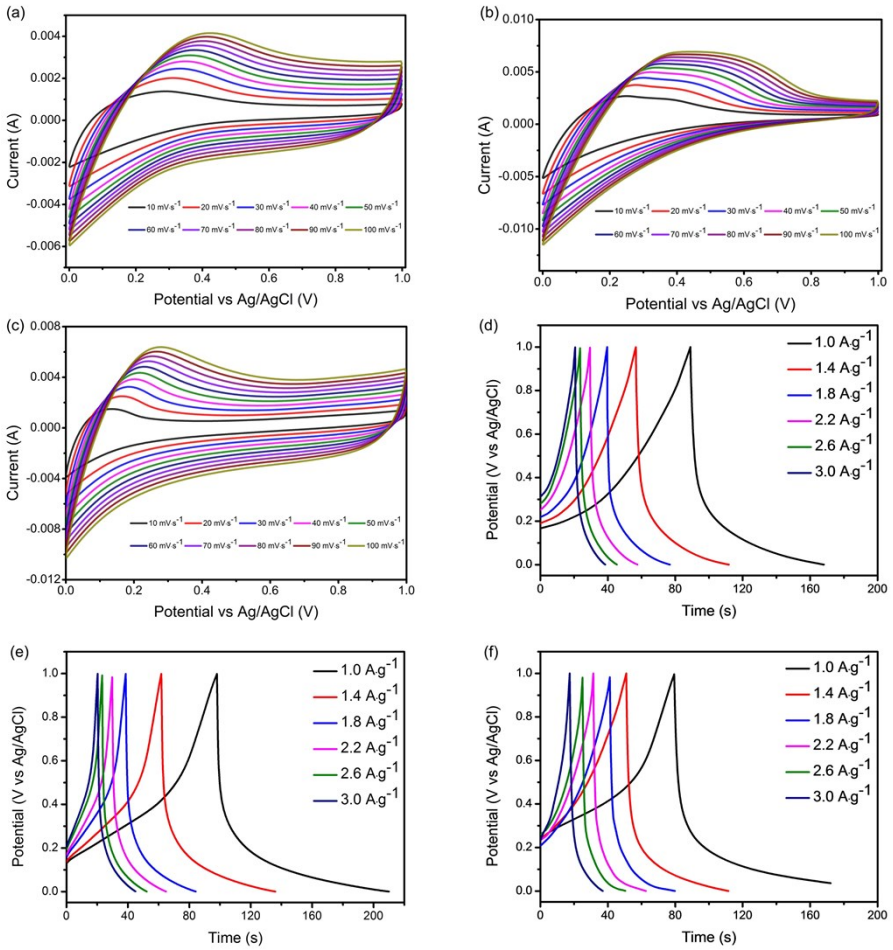

Fig. S4 CV curves of as-prepared NP-1 (a), NP-2 (b) and NP-3 (c) and GCD curves of symmetric supercapacitor composed of NP-1(d), NP-2(e) and NP-3(f) at current density of 1.0 to 3.0 $A \cdot g^{-1}$.

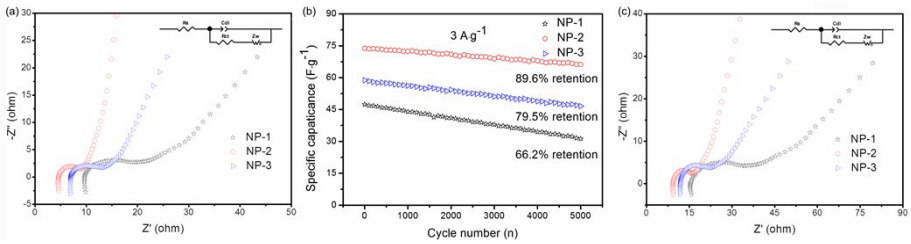

Fig. S5 (a) EIS spectra of symmetric supercapacitors. (b) Cyclic stabilities at current density of 3 $A \cdot g^{-1}$. (c) EIS spectra of symmetric supercapacitors after cycle test.

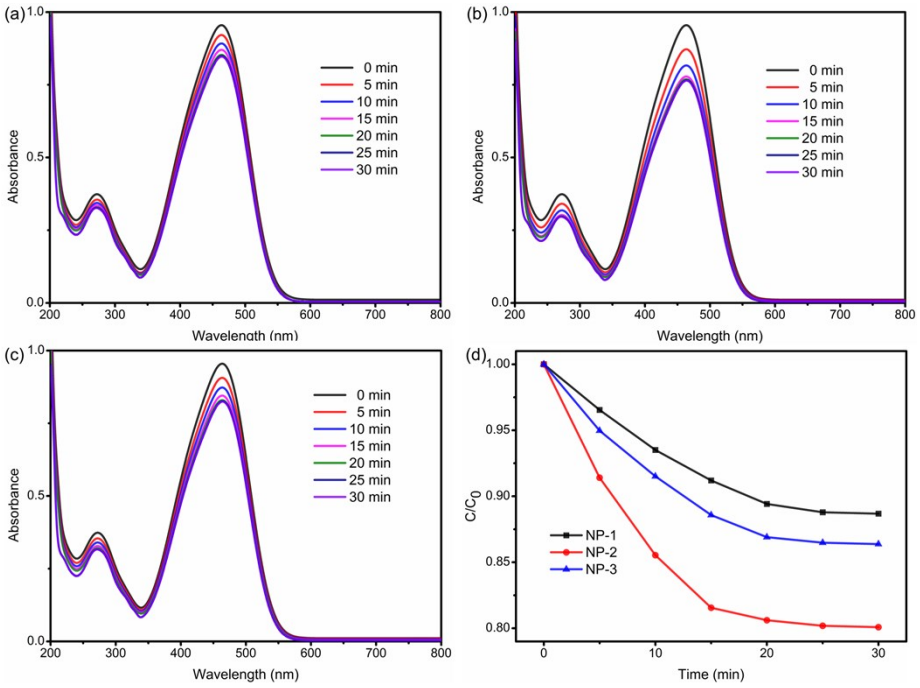

Fig. S6 Absorbance changes of MO solution under the action of NP-1(a), NP-2(b), and NP-3(c), (d) The variation of C/C_o of MO solution.

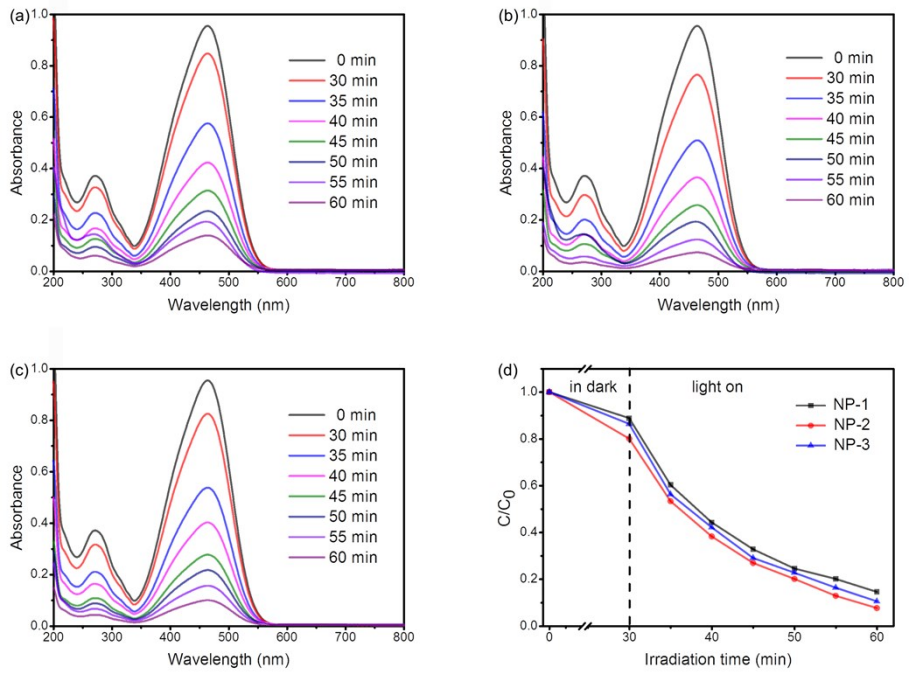

Fig. S7 The change in absorbance at different time intervals for irradiation of MO with NP-1(a), NP-2(b), and NP-3(c) and the change in C_t/C_o as a function of time for degradation of MO in the presence of NP-1, NP-2, and NP-3(d).

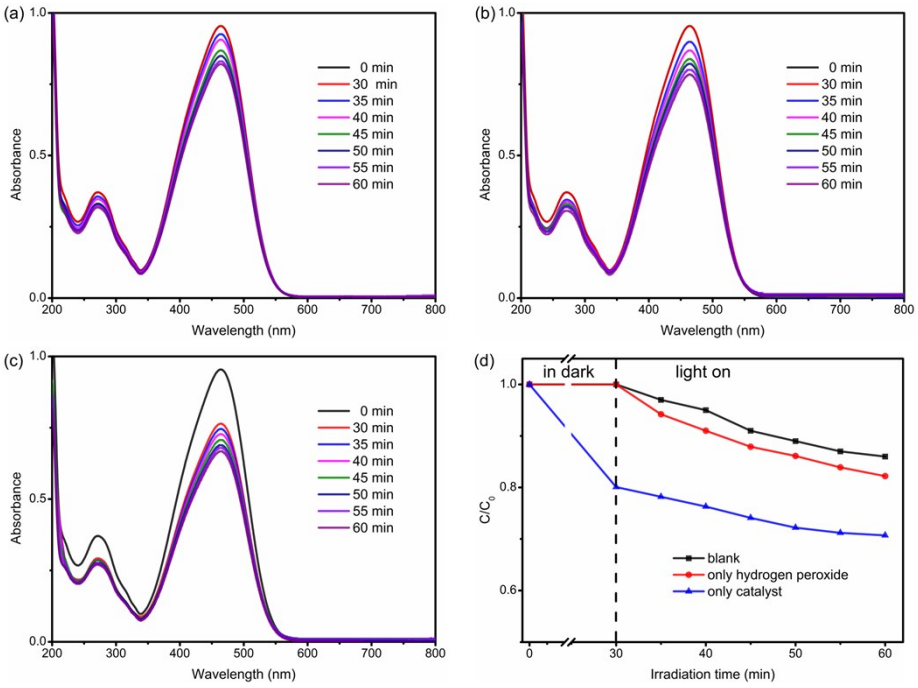

Fig. S8 The change in absorbance at different time intervals of MO in the presence of blank(a), only hydrogen peroxide(b), and only catalyst(c) and the change in C_t/C_o as a function of time for degradation of MO (d).

Table. S1 Comparative chart for photocatalytic performance of photocatalyst reported in recent literatures.

Catalyst Morphology	Contaminant	Dose	Efficiency	Light source	Ref
Flake-like CuS	Congo Red	50 mg	78%/120 min	Mercury lamp (8W)	[1]
Spherical CuS	MB	25 mg	99%/40 min	Xe lamp (500W)	[2]
Spherical CuS-WO_3	RhB 4 mg/L	50 mg	96%/150 min	Xe lamp (500W)	[3]
$CoFe_2O_4$@CuS particle	Penicillin G10 mg/L	0.2 g/L	70.7%/120 min	Ultraviolet light (18W)	[4]
CuS Microsphere	MB 5.8 mg/L	20 mg	85.4% in 5 h	Daylight lamp (25W)	[5]
Cubic CuS	MB	-	75.1%/40 min	Natural light	[6]
CuS Nanoparticle	MB 1×10^{-4} (M)	5 mg	82%/ 5 h	-	[7]
CuS Nanoplate	MB 20 mg/L	30 mg	87%/40 min	Xe lamp (150 W)	[8]
CuS/$BiVO_4$ compound	Ciprofloxacin 10 mg/L	100 mg	8.1%/90 min	Xe lamp (300 W)	[9]
CuS Nanoflower	MB 2×10^{-5} M	20 mg	62%/20 min	Florescent lamp (40 W)	[10]
Bulk CuS-zeolite	MO 10mg/L	0.1 g/L	48%/420 min	Direct sunlight	[11]
CuS-Cu_2S Nanoparticle	MO 10^{-5} M	10 mg	9.39%/180 min	Direct sunlight	[12]
Ag doped TiO_2 sphere	MO	50 mg	60%/140 min	Xe lamp (500 W)	[13]
NP-2	MO	15 mg	93.8%/60 min	Xe lamp (300 W)	**Our work**

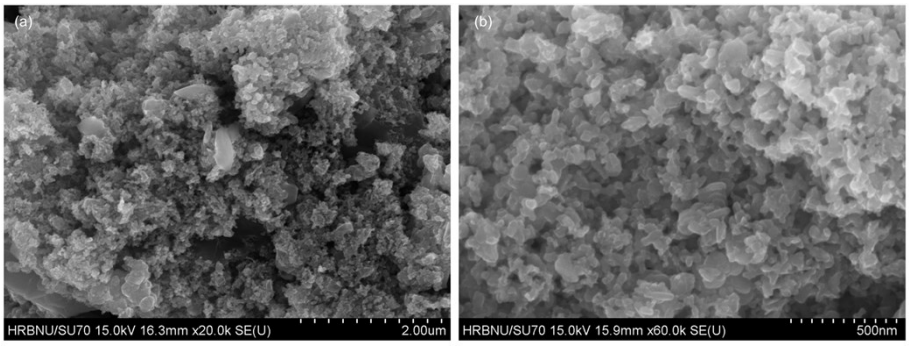

Fig. S9 SEM images of the NP-2 at different magnification after 5 cycle experiments.

Reference

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