

## Supplementary Information

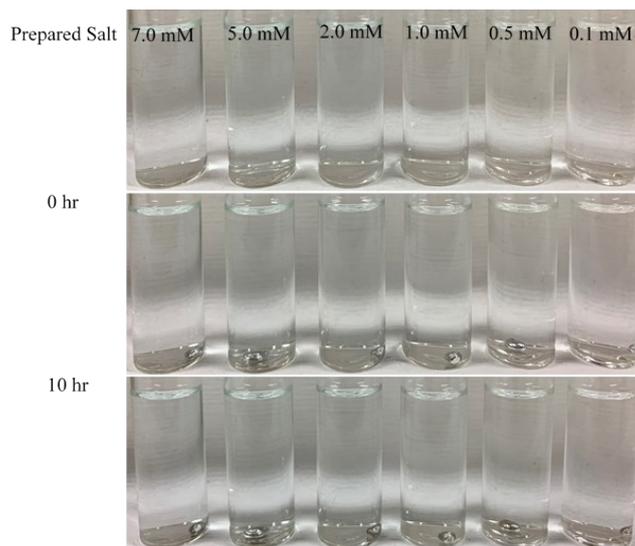
### Galvanic Replacement of Liquid Metal Galinstan with Copper for the Formation of Photocatalytically Active Nanomaterials

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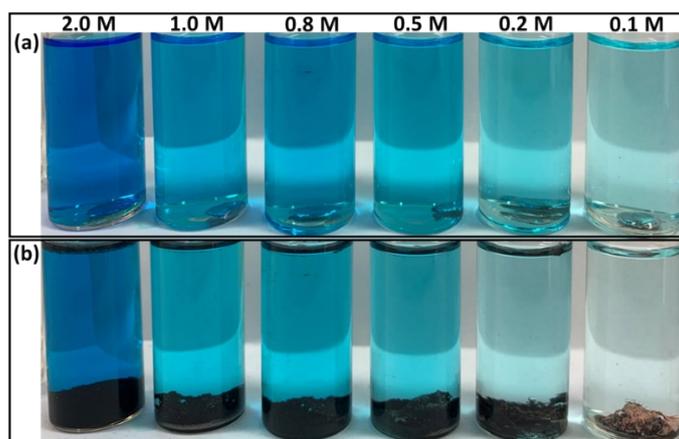
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**Figure S1.** Digital images of a liquid metal galinstan droplet in different concentrations (low) of neutral copper salt ( $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ) at 0 hour, and 10 hours.



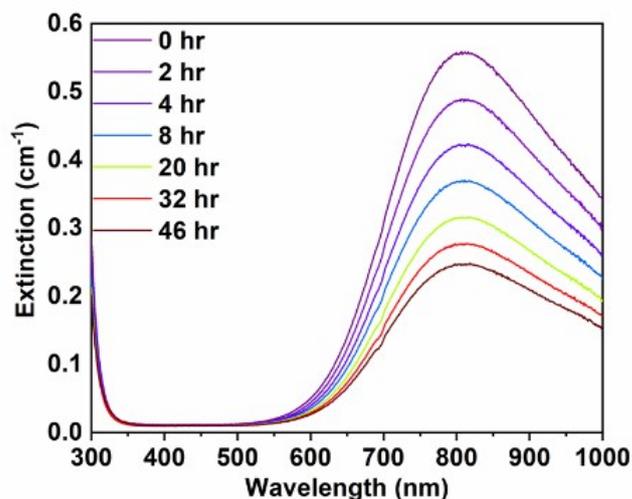
**Figure S2.** Digital images of a liquid metal galinstan droplet in 7.0 mM copper salt ( $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ) after 24 hours of galvanic replacement reaction at room temperature, showing the formation of brownish copper pigment at the surface of bulk galinstan drop.



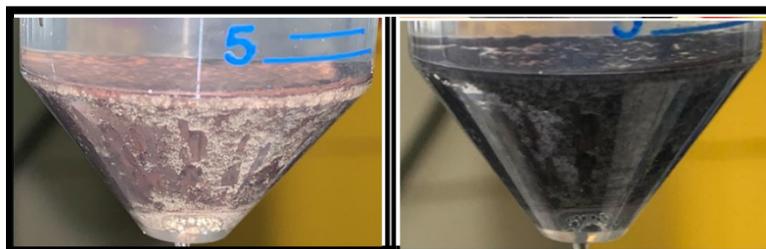
**Figure S3.** Digital images of a liquid metal galinstan droplet in different concentrations of neutral copper salt ( $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ) at (a) 0 hour and (b) 24 hours.



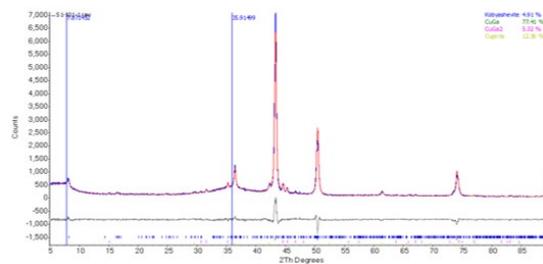
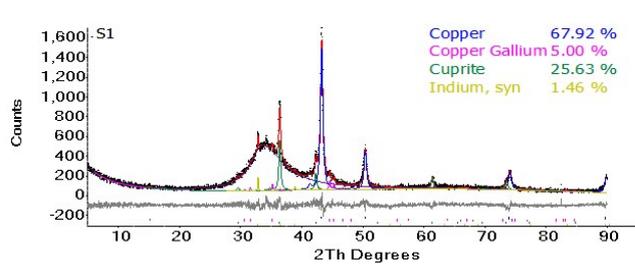
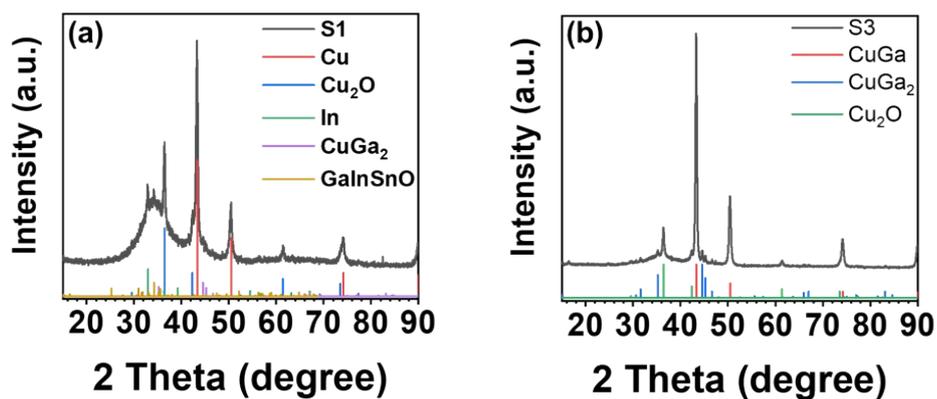
**Figure S4.** Digital images of a liquid metal galinstan droplet in 0.1 M copper salt ( $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ) after 24 hours of galvanic replacement reaction at room temperature.



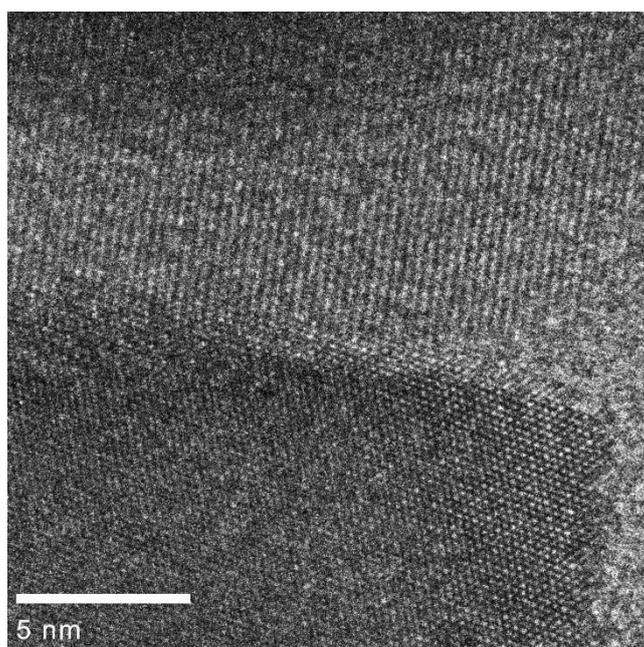
**Figure S5.** Reduction in the intensity of absorption of 0.1 M CuSO<sub>4</sub> solution when exposed to liquid metal Galinstan (note solution was diluted with water prior to measuring the UV-vis spectra to ensure good quality spectra with an intensity < 1 a.u.).



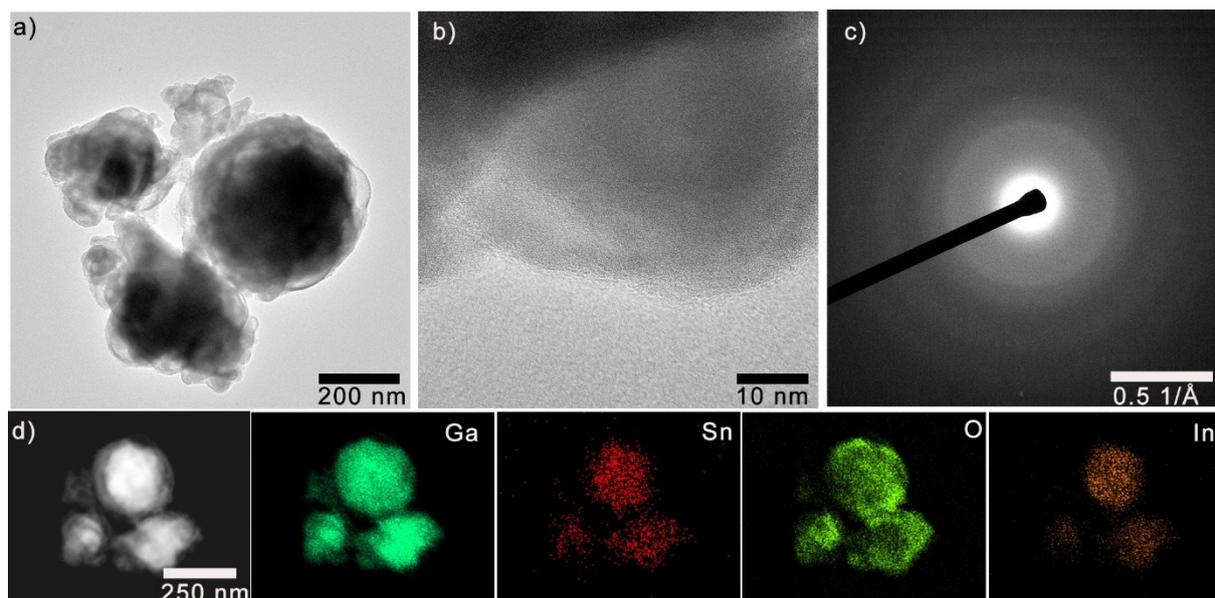
**Figure S6.** Digital images of the reaction vial after galinstan droplet was reacted with 1 M CuSO<sub>4</sub> after 72 hours (a) acidified solution (pH 3.74) and (b) CuSO<sub>4</sub> in DI water.



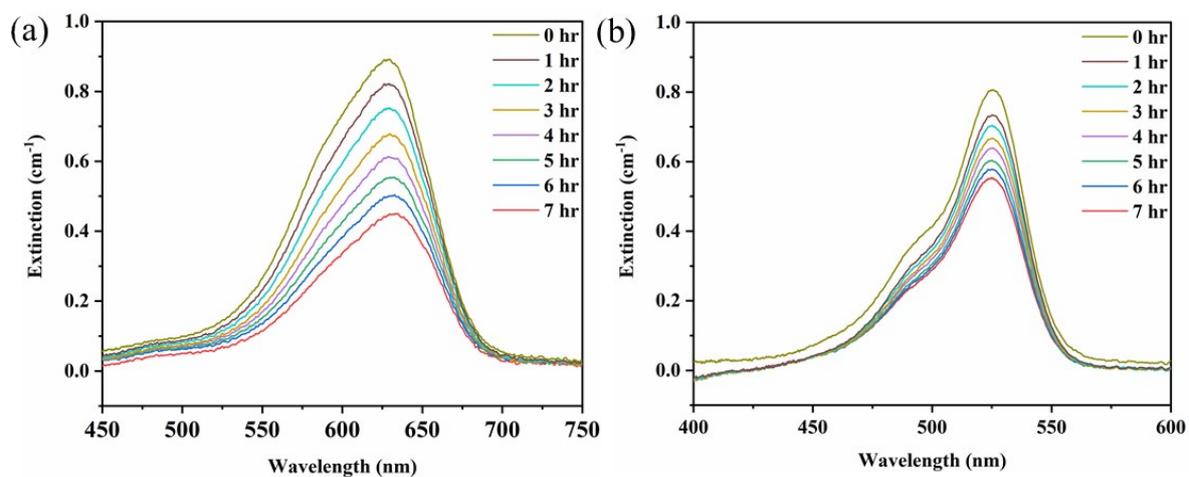
**Figure S7.** XRD pattern of (a) sample S1 and (b) sample S3 where Rietveld refinement of the patterns are also shown.



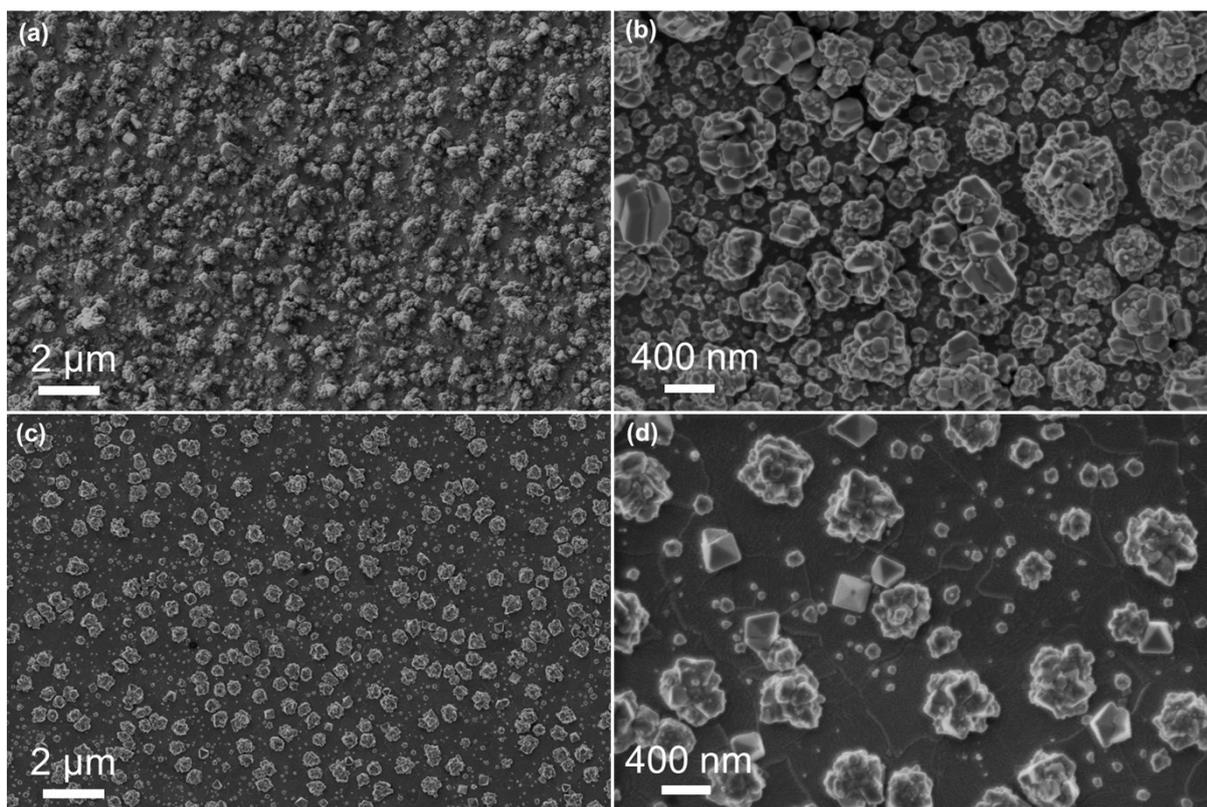
**Figure S8.** HRTEM image of sample S1.



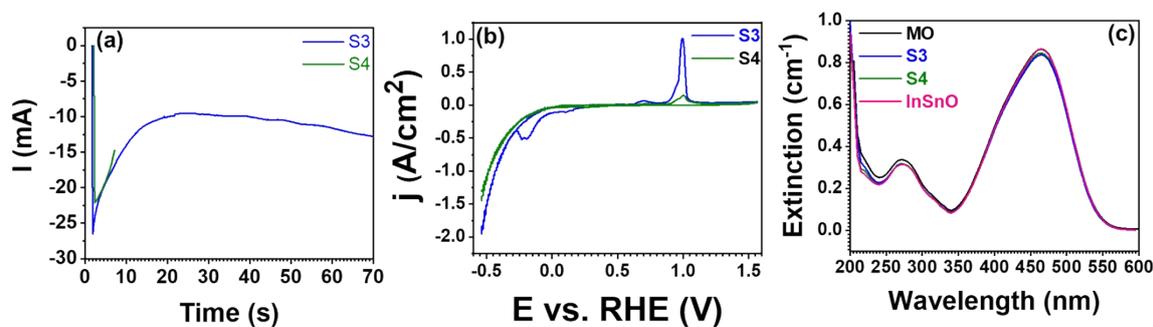
**Figure S9.** Low magnification TEM image of GaInSn sonicated in acidified 5 mM  $\text{CuSO}_4$ , (b) high resolution TEM image, (c) SAED pattern and (d) STEM image and corresponding EDX maps.



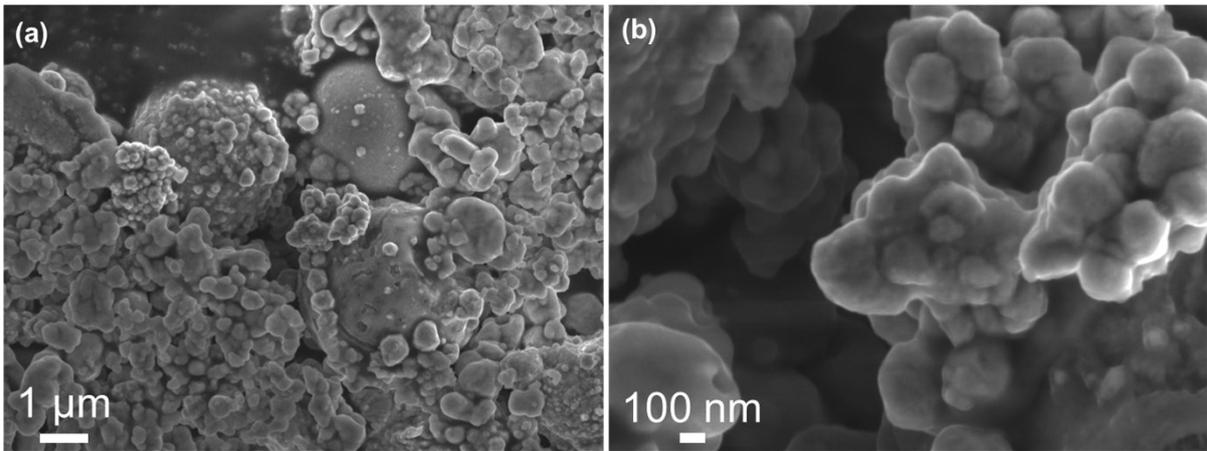
**Figure S10.** (a) S1 (1.3mg) photocatalytic degradation curve of RhB (b) S1 (1.1 mg) photocatalytic degradation curve of TB



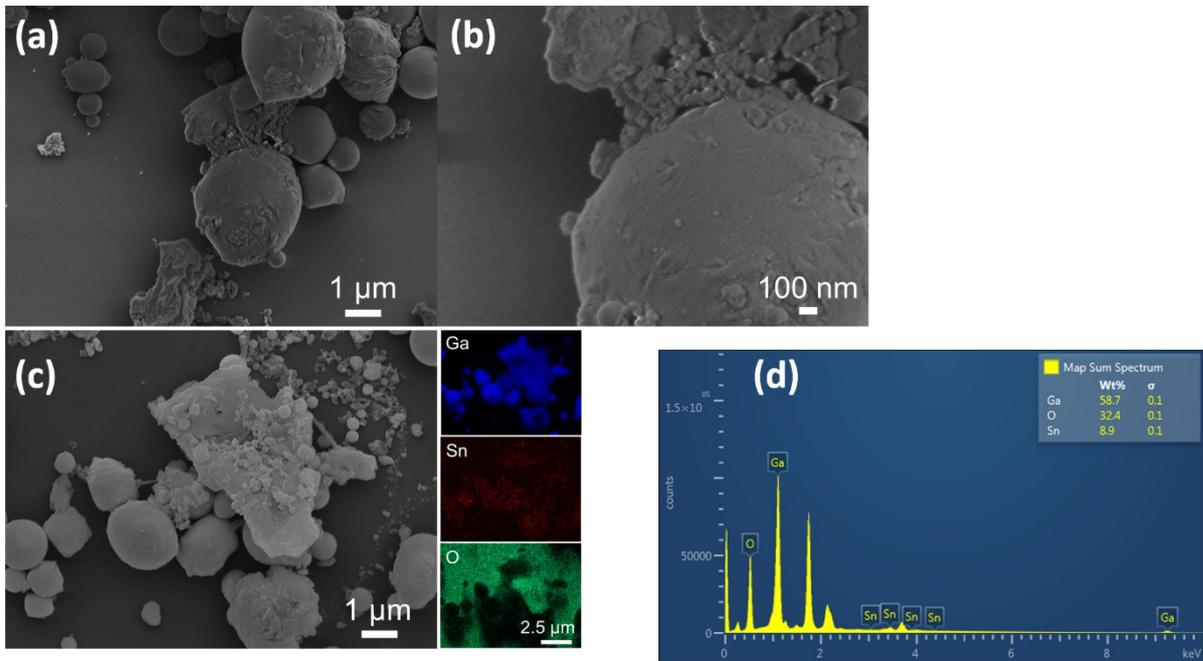
**Figure S11.** (a, b) SEM images of sample S4 (c, d) SEM images of sample S5.



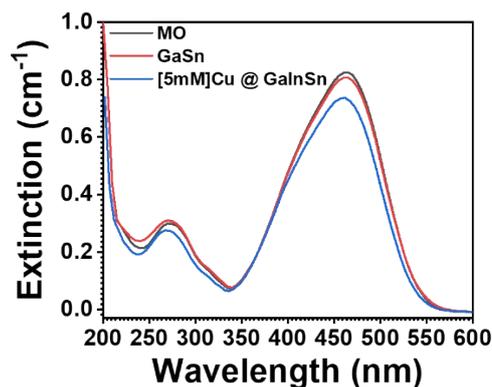
**Figure S12.** (a) chronoamperometry graph showing electrodeposition of copper nanoparticles for sample S4 and S5 on ITO (b) Cyclic voltammetry of the as-deposited Cu nanoparticles (S4 & S5) recorded in 1 M NaOH, (c) Photocatalytic degradation of methyl orange under visible light conditions monitored by UV-vis spectrometry of samples S4, S5 and InSnO (ITO).



**Figure S13.** SEM images of sample S3.



**Figure S14.** Liquid GaSn (10 wt % Sn) after sonication in acidic conditions (a-b) SEM images, (c) EDX mapping and (d) EDX spectrum.



**Figure S15.** Photocatalytic degradation of methyl orange under solar simulated conditions monitored by UV-vis spectrometry of GaSn system (Figure S14) and GaInSn sonicated in acidified 5 mM CuSO<sub>4</sub> (Figure S9).

**Table S1.** Summary of synthesis conditions

Sample ID	Synthesis Method	Starting materials	Added materials
S1	Sonication/Galvanic reaction	Acidified water + GaInSn	CuSO <sub>4</sub> [0.2 M]
S2	Sonication/Galvanic reaction	Acidified water + GaInSn	-
S3	Sonication/Galvanic reaction	Acidified water + Gallium	CuSO <sub>4</sub> [0.2M]
S4, S5	Electrodeposition	CuSO <sub>4</sub> .5H <sub>2</sub> O + H <sub>2</sub> SO <sub>4</sub>	-

Samples S4 and S5 are electrodeposited Cu nanomaterials on ITO electrodes from 50 mM CuSO<sub>4</sub> in acidic medium, S4 was electrodeposited on InSnO (ITO) for a duration of 70s at -1.0V vs. Ag/AgCl while S5 was deposited for only 10 s at the same experimental condition.

**Table S2.** Brisbane, Australia weather report for June 24, 2019, at exact time the investigation was carried out<sup>[1]</sup>

Time (AEST)	Temperature (°C)	Dew Point (°C)
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9:00	15.0	7.3
10:00	16.6	6.7
11:00	18.1	7.2
12:00	18.5	6.7
13:00	19.7	6.8
14:00	20.3	7.7
15:00	18.7	7.8
16:00	17.8	8.4

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[1] Observations for Brisbane, <http://www.bom.gov.au/>, accessed: June 24, 2019.