Supporting Information

Comparison Study on the Stability of Copper Nanowires and Their Oxidation Kinetics in Gas and Liquid

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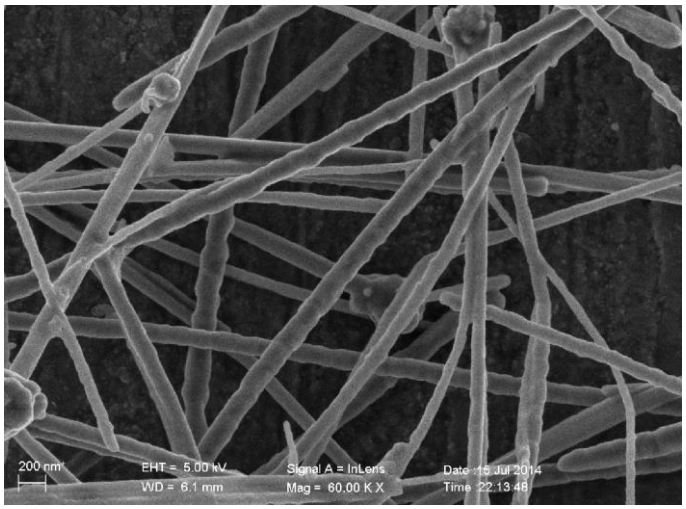


Figure S1. SEM image of fresh CuNWs.

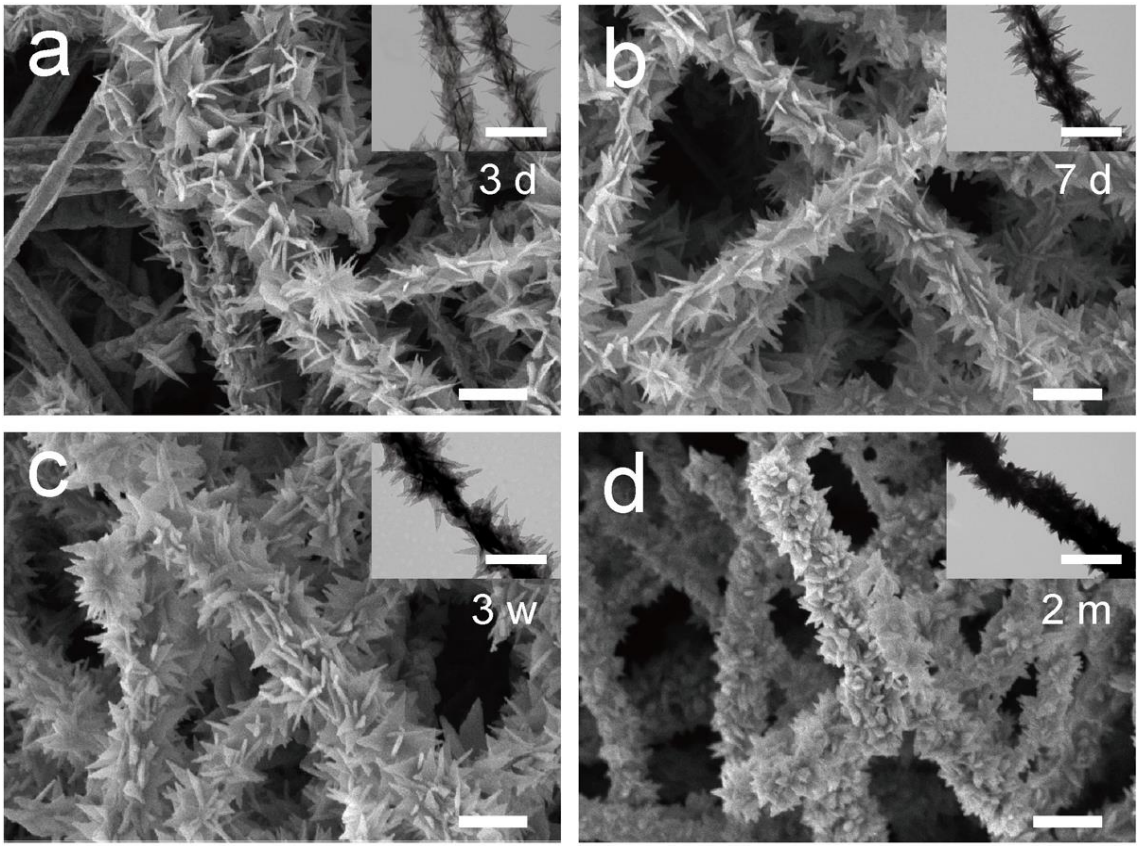


Figure S2. SEM and TEM images of CuNWs stored in water at room temperature after: (a) 3 days; (b) 7 days; (c) 3 weeks; (d) 2 months. Insets are corresponding TEM images of CuNWs. All scale bars are 500 nm.

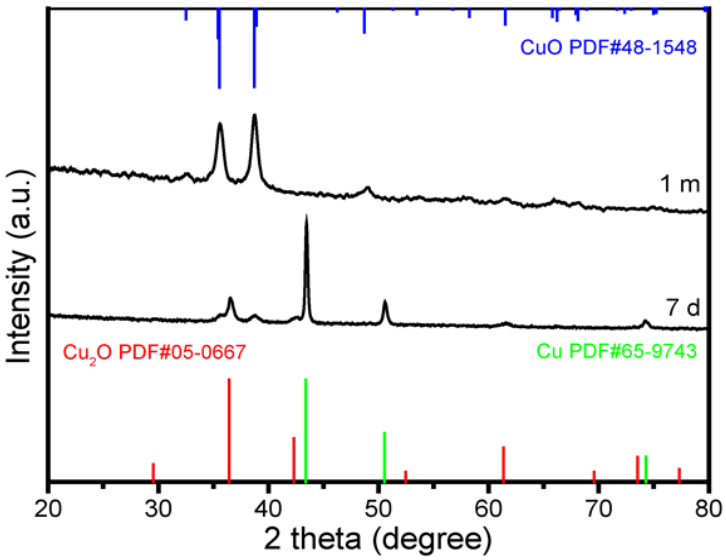


Figure S3. Evolution of XRD patterns for CuNWs during oxidation in water at room temperature after 7 days and 1 month.

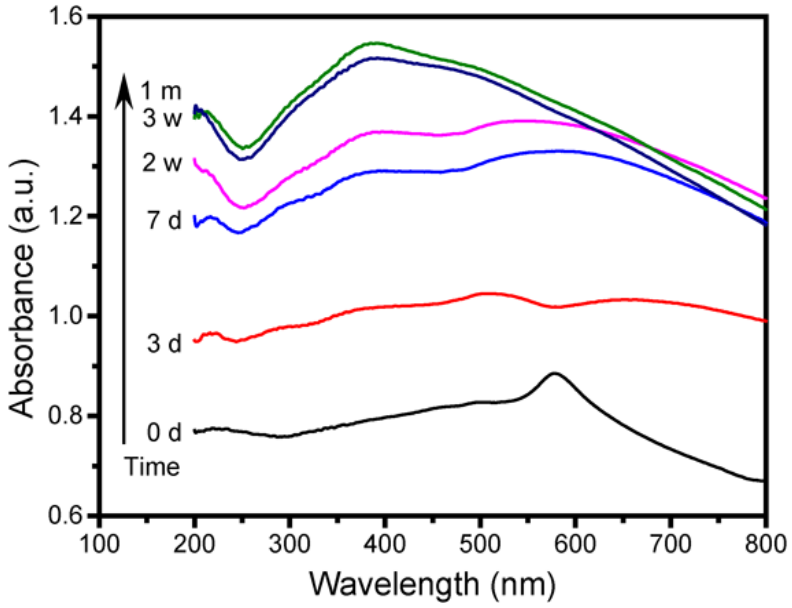


Figure S4. Evolution of UV–Vis absorption spectra for CuNWs during storage in water at room temperature after: 0 day; 3 days; 7 days; 2 weeks; 3 weeks; 1 month.

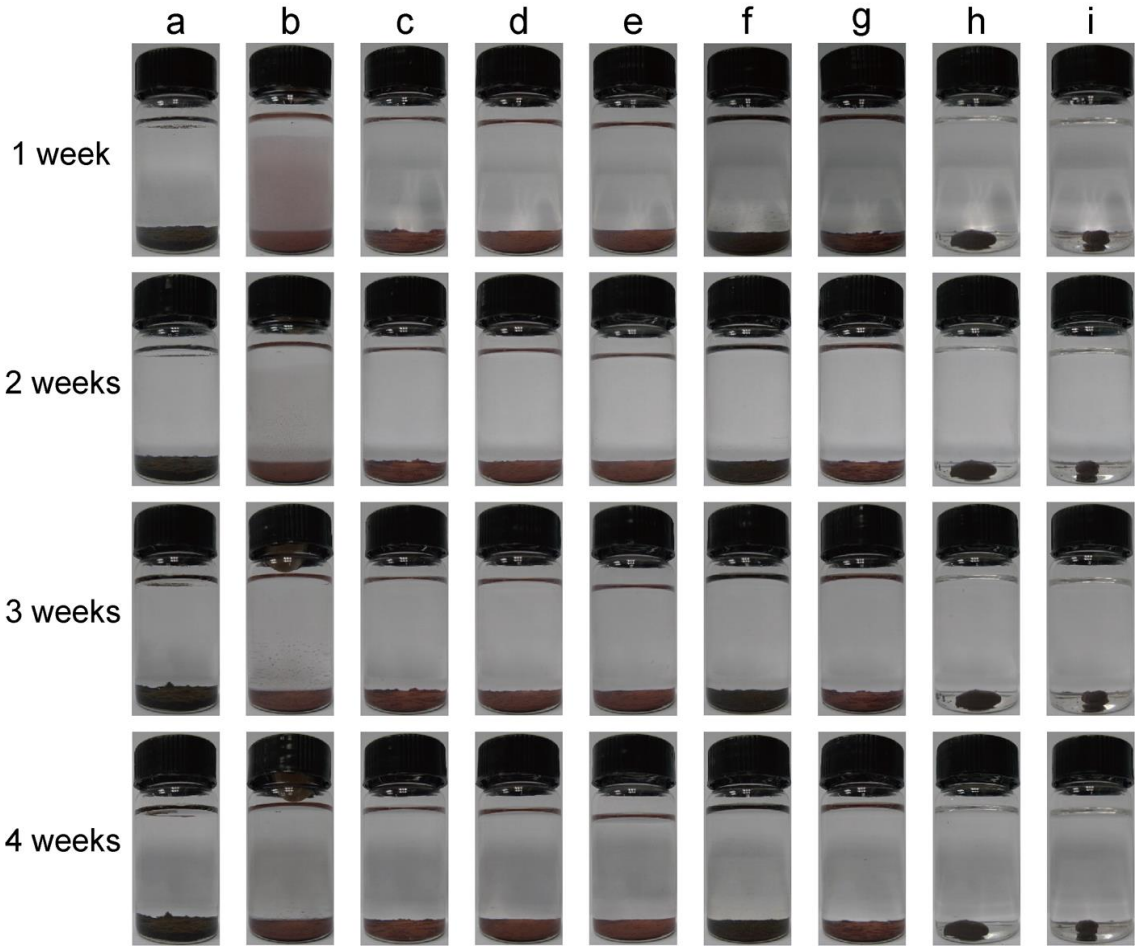


Figure S5. Photographs of CuNWs solution stored at room temperature in different solvents. (From left to right: (a) H_2O, (b) ethylene glycol, (c) methanol, (d) ethanol, (e) isopropanol, (f) dimethyl sulfoxide, (g) N,N-dimethylformamide, (h) n-hexane, and (i) cyclohexane.)

Notes: CuNWs being stored in water, n-hexane, and cyclohexane turned to black, indicating that the CuNWs were heavily oxidized. As to CuNWs being stored in DMSO, the black color of storing CuNWs may result from the oxidation and the reaction between CuNWs and DMSO. Because DMSO can cause copper corrosion when water is presence.

Table S1. Binding Energies (eV) of Cu $2p_{3/2}$, O1s and Cu LMM

	Cu	Cu_2O	CuO	OH^-/CO_3^{2-}
Cu 2p	932.2-932.7	932.0-932.6	933.4-934.1	—
O 1s	—	530.4-530.7	529.5-530.0	531.5
Cu LMM	918.2-919.0	916.2-917.0	917.5-918.5	—

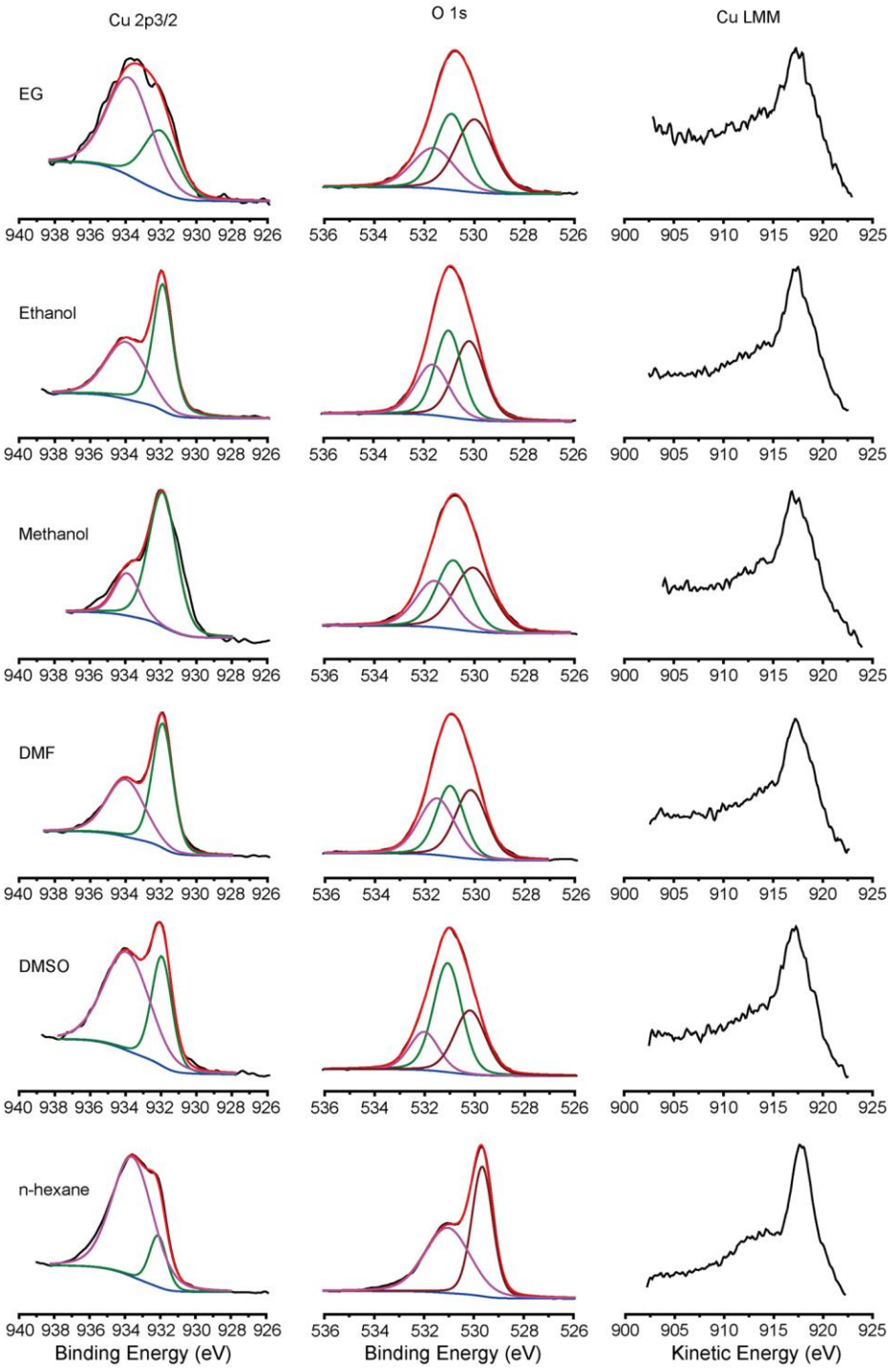
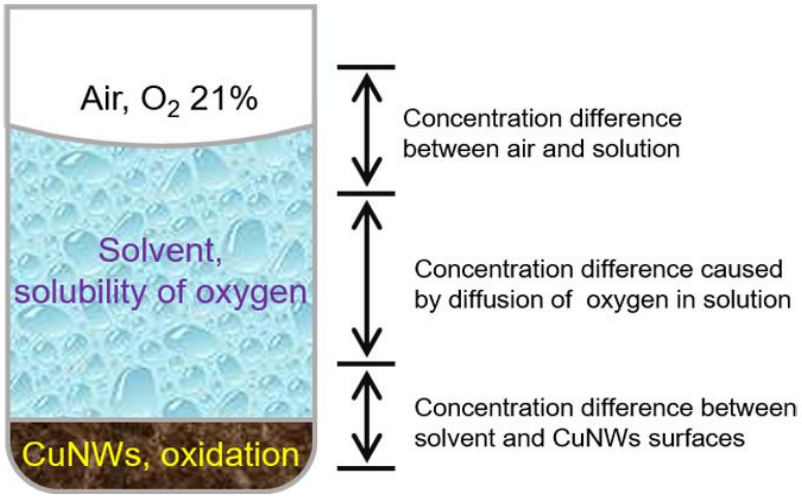


Figure S6. Deconvolution of XPS spectra in Cu $2p_{3/2}$ and O 1s region and Cu LMM spectra for the samples being stored in other solvents.

Notes: As shown in Figure S6, all samples displayed two peaks observed at about 933.5 eV (CuO) and 932.2 eV (Cu/Cu_2O). For the samples stored in polar organic solvents, the corresponding O 1s spectra of these samples displayed two main peaks for Cu_2O (about 530.5 eV) and CuO (about 530.0 eV) and a side peak for OH^- and CO_3^{2-} (about 531.5 eV). As to the sample being stored in n-hexane, the corresponding O 1s spectra only displayed a main peak for CuO (about 530.0 eV) and a side peak for OH^- and CO_3^{2-} (about 531.5 eV).



Scheme S1. Concentration differences of oxygen in CuNWs oxidation during storage.

Table S2 Equilibrium constant for copper oxidation at 298.15 K

Reaction	E^0	lgK^0	K^0
$O_2 + 4\ H^+ + 2\ Cu \rightarrow 2\ H_2O + 2\ Cu^{2+}$	0.887 V	59.93	$8.69\times10^{59}>>1$
$O_2 + 4\ Cu \rightarrow 2\ Cu_2O$	1.589 V	107.36	$2.32\times10^{107}>>1$

Notes:

As to copper oxidation:

$O_2 + 4\ H^+ + 4\ e \rightleftharpoons 2\ H_2O$ E=1.229 V

$Cu^{2+} + 2\ e \rightleftharpoons Cu$ E=0.342 V

$Cu_2O + H_2O + 2\ e \rightleftharpoons 2\ Cu + 2\ OH^-$ E=–0.360 V

Based on $\Delta_r G_m^0 = -RTlnK^0 = -nFE^0$ and $lgK^0 = nE^0/0.0592$, we can easily obtain the equilibrium constant for copper oxidation (Table S2). Obviously, the oxidation of copper is a spontaneous reaction in thermodynamics.

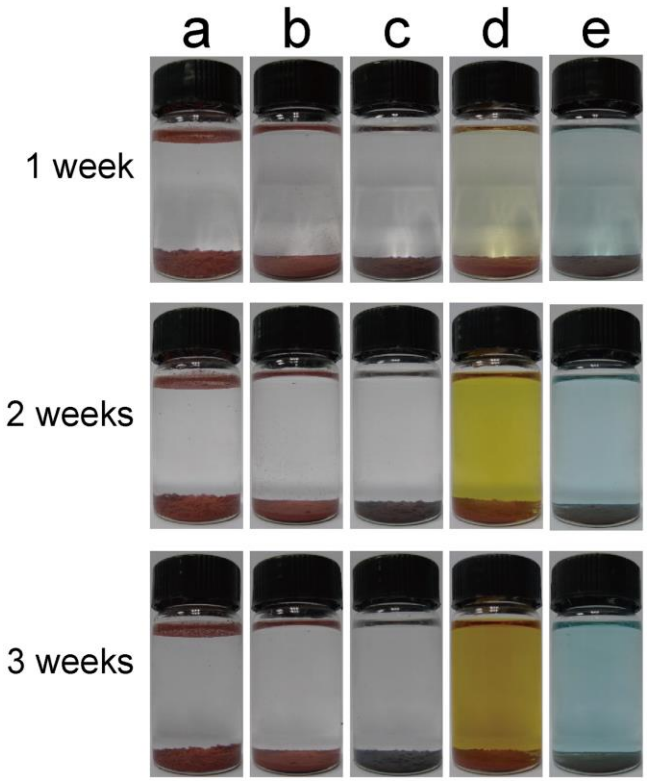


Figure S7. Photographs of CuNWs solution stored under the protection of (a) $N_2H_4 \cdot H_2O$ (in water), (b) $N_2H_4 \cdot H_2O$ (in EG), (c) ascorbic acid, (d) citric acid, and (e) glucose.