

SUPPORTING INFORMATION:

Experimental details:

A. Elimination of copper core. In a typical processing experiment as-prepared products (50 mg) were stirred in concentrated HNO_3 (4mL) at room temperature for 0.5 h in order to dissolve the metal nanowires, followed by centrifuged at low speed (2000rpm) to collect products and then washed with distilled water (three times). In the final step of processing, sample was resuspended in ethanol.

B. Elimination of amorphous carbon sheath. Cu@C NWs were placed in a quartz tube furnace settled on a boron nitride coated heater in CVD chamber. The system was first vacuumized and flushed by high-purity N_2 for 5 min with flow 2000 sccm (standard cubic centimeters per minute) to ensure no water remained, afterwards a gas mixture of 20% O_2 in N_2 (air may also be used) was passed through a gas bubbler and over the sample at total flow rate of 500 sccm. Nanowires were heated at 300 °C for 2 h, followed by heating in H_2 at 500~600 °C. Whereas in air oxidation the amorphous carbon is removed by oxidation and converted into CO_2 , in the course of treatment by introducing H_2 at elevated temperatures oxidized copper core which efficiently converted to copper on hydrogen.

C. Electrical measurement. Our experiments were performed in a STM equipped with a CAPRES A/S M4PP monolithic Microscopic Four-Point Probes serving as a manipulator. The reason is that four-terminal I-V measurements were done by sweeping the bias voltage between tips A and D with recording of the current flow I and the voltage drop V between tips B and C (Scheme SI-2). Voltage probes absorbed current less than 0.1 pA in these I-V measurements, which is negligibly small compared with the measurement current. They work under scanning electron microscope in ultra-high vacuum (UHV), enabling precise probe positioning on aimed areas on the Cu@c NWs surface. But the conductivity measurements can be done only at room temperature, which limits the physics we can discuss from the data. Nanowires was placed on top of the contacts to avoid mechanical deformation of the wires, resistances of the order of gigaohms were recorded.

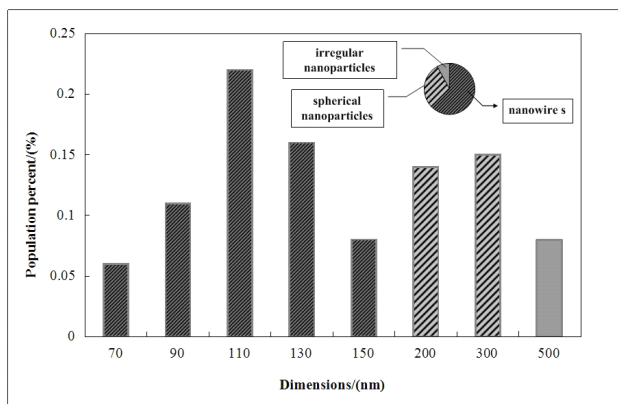


Figure SI-1. The size distribution of products (copper nanowires, nanospheres, and irregular nanoparticles) formed at 150 °C for 15 h. .

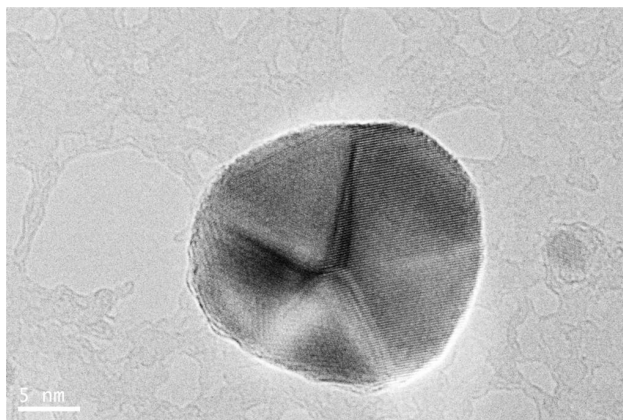


Figure SI-2. Bright-field TEM image of Cu NW (top view) sliced perpendicular to its growth axis

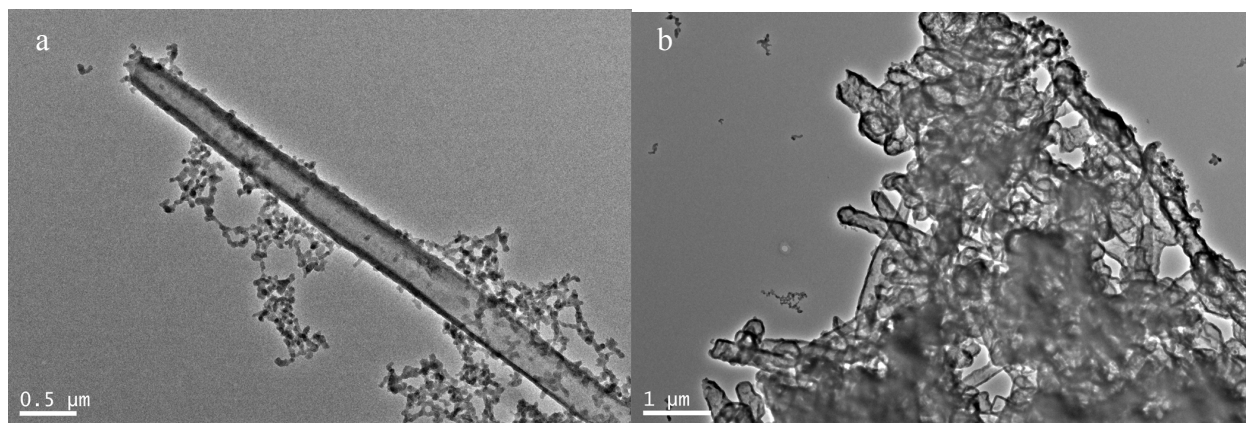


Figure SI-3. TEM images of (a) detailed and (b) general views of Cu core corroded by acid treatment.

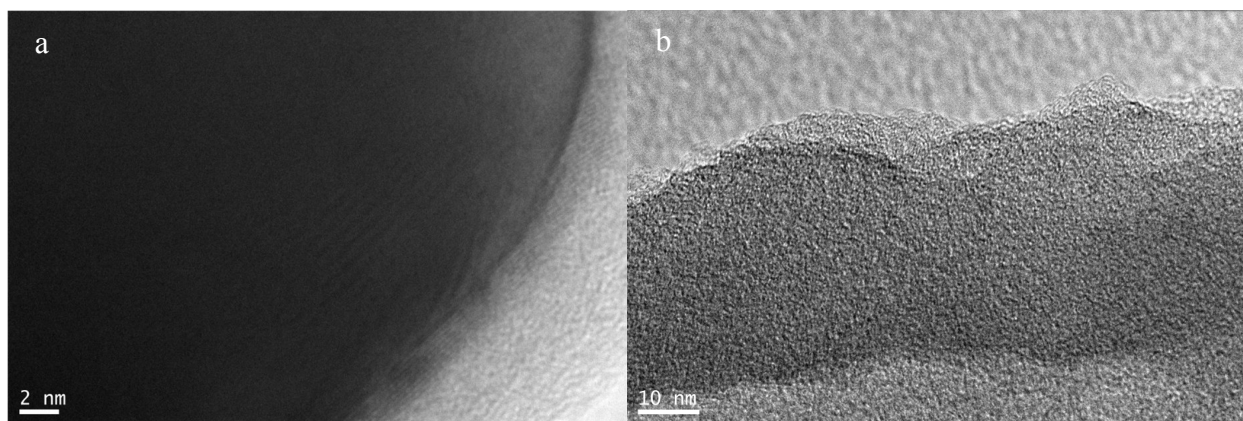


Figure SI-4. HRTEM image of a (a) Cu@C nanowire and (b) amorphous carbon sheaths.

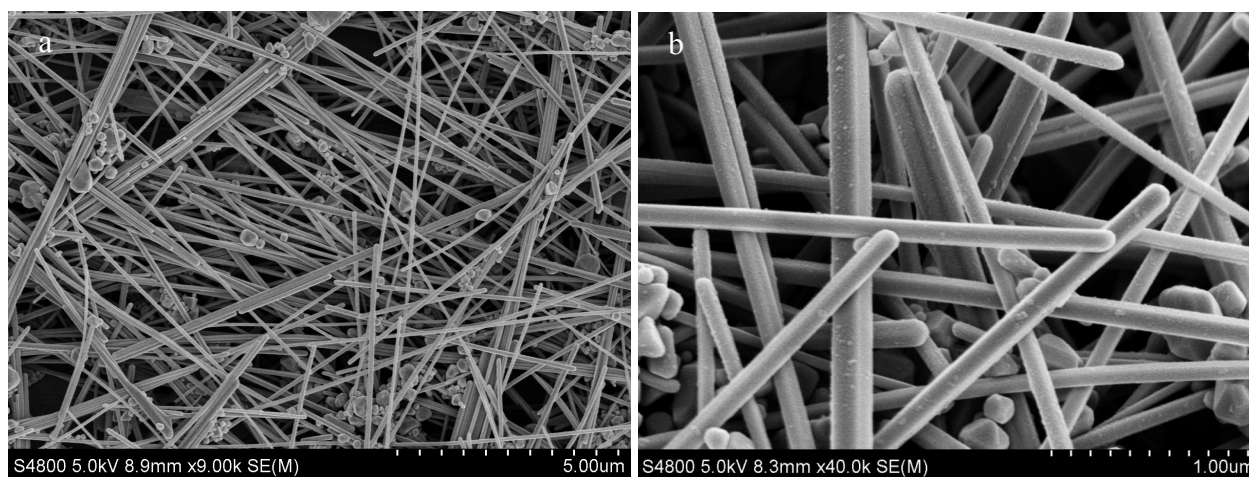


Figure SI-5. SEM images of copper nanowires synthesized by a polyol-thermal approach at 160° C for 24 h in the presence of PVP separated by centrifugation at 10000 rpm.

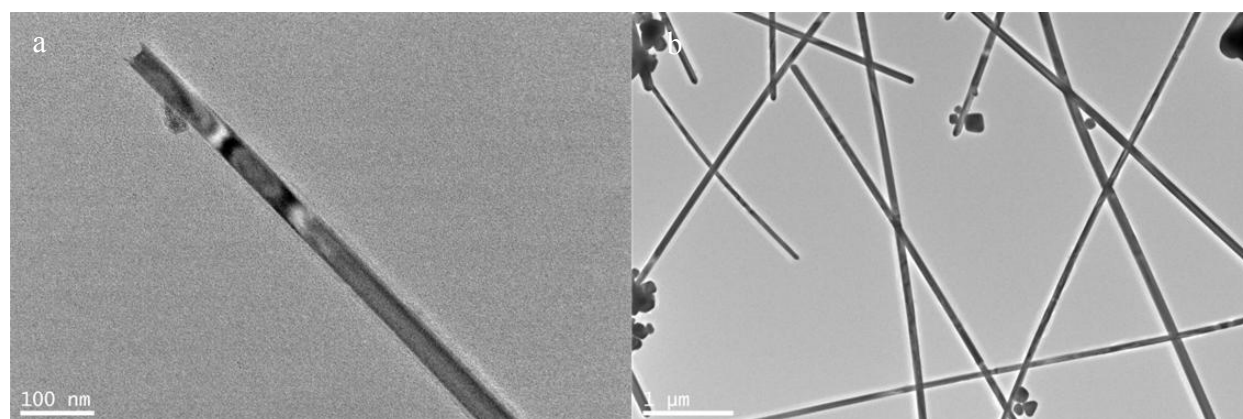


Figure SI-6. TEM images of a single copper nanowires with the diameter of 50 nm or less.

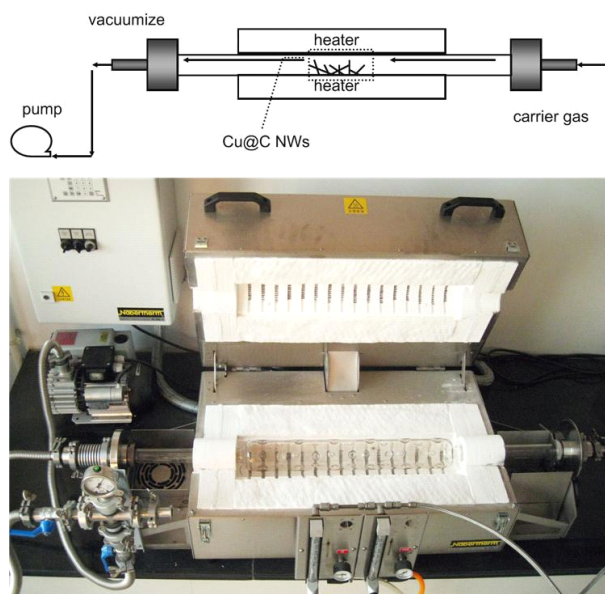


Figure SI-7. Schematic image of the preparation apparatus for elimination of amorphous carbon sheath.

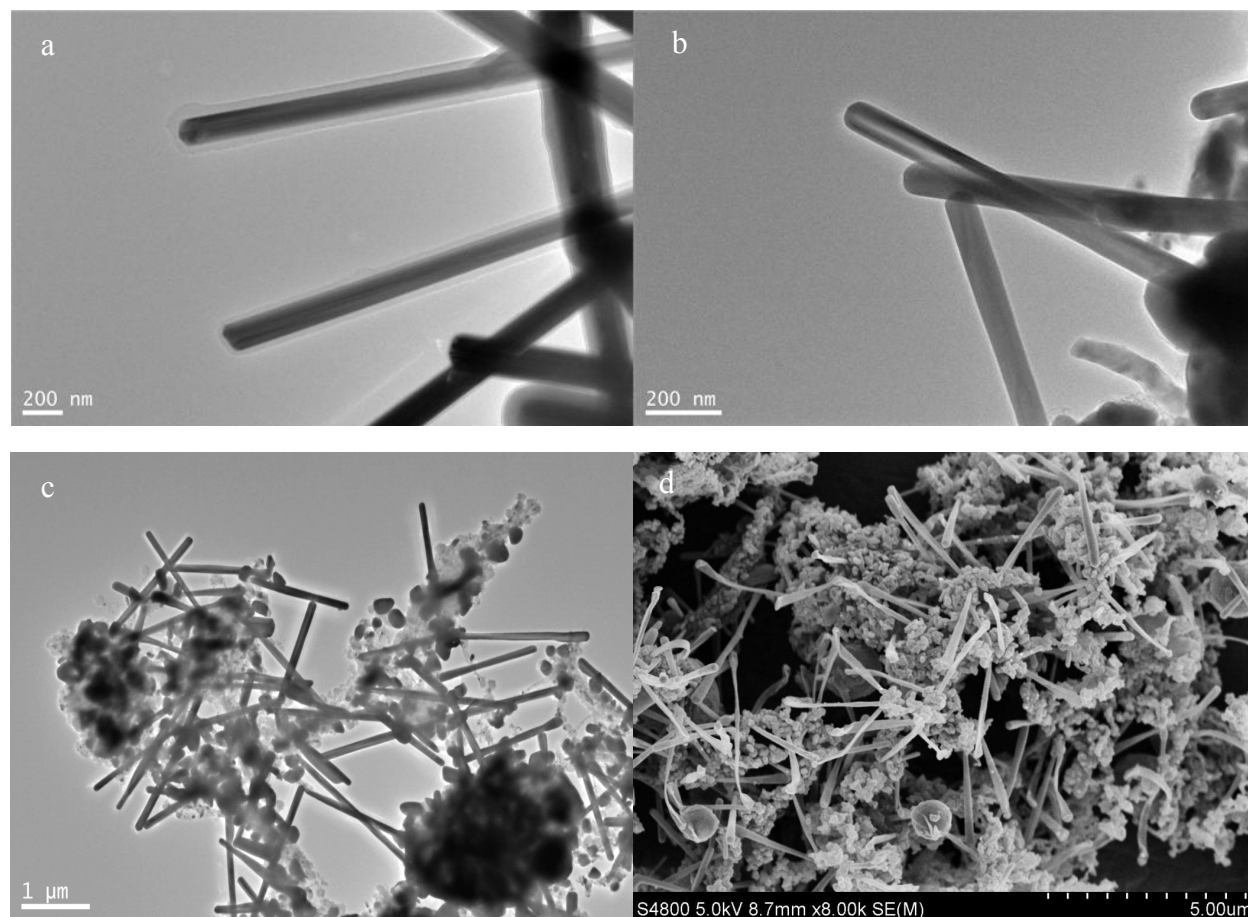


Figure SI-8. TEM images of (a) Cu@C NWs wrapped by amorphous carbon; (b) Copper core NWs after high-temperature vacuum treatment to remove the carbon shells; (c) TEM and (d) SEM for large area of many Cu NWs after high temperature purification treatment.

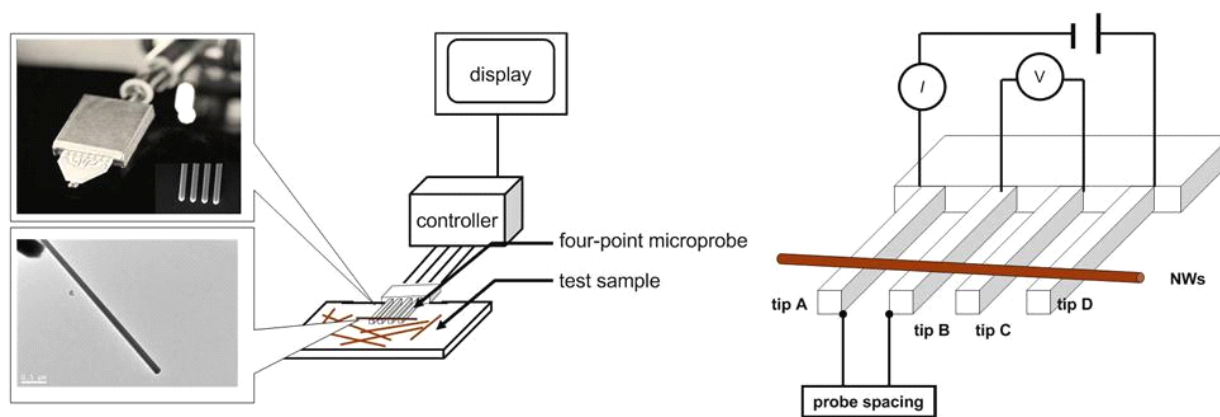


Figure SI-9. Scheme image shows around the voltage probes (tips A-D) touching on a NW and corresponding four-terminal I-V curves.