Supporting Information

Lotus Leaf-inspired CVD grown Graphene for a Water Repellant Flexible Transparent Electrode

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Materials

Cu foil (25 μm, Alfa Aesar), SYLGARD 184 Silicone Elastomer kit (Dowcorning Co.), Ammonium persulfate (Aldrich Co), Polymethyl methacrylate (Alfa Arsar).

Synthesis of CuO

The Cu foil was cleaned in acetone and deionized water for 10 min using an ultrasonic generator and then thermal-treated at various temperatures.

Chemical Vapor Deposition of Graphene on 3D Cu

The samples were placed in quartz tube (Scientech Co.) and temperature in heat-zone was increased up to 1000 ^{o}C with H_2 under the pressure of 0.90 torr. When temperature reached at 1000 ^{o}C, the heat-zone was moved to the sample. Then the temperature decreased to 740 ^{o}C and the temperature was increased up to 1000 ^{o}C. After reaching 1000 ^{o}C, the temperature at heat-zone was maintained for 30 min to reduce from CuO to Cu. Then, CH_4 gas was flowed with 24 sccm for 25 min under the pressure of 1.0 torr. Finally, the sample was rapidly cooled down to room temperature with flowing H_2 and CH_4 under the pressure of 1.0 torr.

Transfer of Graphene

PDMS precursors were prepared using the SYLGARD 184 Silicone Elastomer kit. The SYLGARD 184 Silicon Elastomer was mixed with Curing agent at a 10 parts to 1 part ratio (10:1). The mixed sample was roll-mixed for 30 min. The graphene on Cu was molded by PDMS and air-bubbles in the sample were removed in a vacuum oven for 1 hr. Then PDMS/graphene/Cu was baked at 80 ^{o}C for 4 hrs in the oven. In succession, fully cured PDMS/Graphene/Cu sample were floated on aqueous solution of 1 M ammonium persulfate for 2 hrs to remove Cu foil. Lastly, the resulting samples were heat-treated at 80 ^{o}C to recover the original hydrophobicity deteriorated by the immersion in harsh hydrophilic solutions.

Characterizations

The morphology of the samples were characterized by Field-Emission SEM (Nova Nano-SEM 230, 15 kV). The quality of graphene was determined by Raman spectroscopy (WITec, alpha300R, excited by a 532nm laser). The sheet resitances of the samples transefered onto Si wafer were characterized by 4 point-probe (Dasol Eng, FPP-RS8, pin-spacing 1 mm, pin-radius 100 μm). The contact angle was measured by a Drop Shape Analysis System DSA100 (Kruss, Germany). The crystal structure of samples were confirmed with a Rigaku Co. High Power X-Ray Diffractometer D/MAZX 2500V/PC from 10^{o} to 80^{o}. Thermal treatment was implemented by a Lenton 1200℃ vacuum tube furnace.

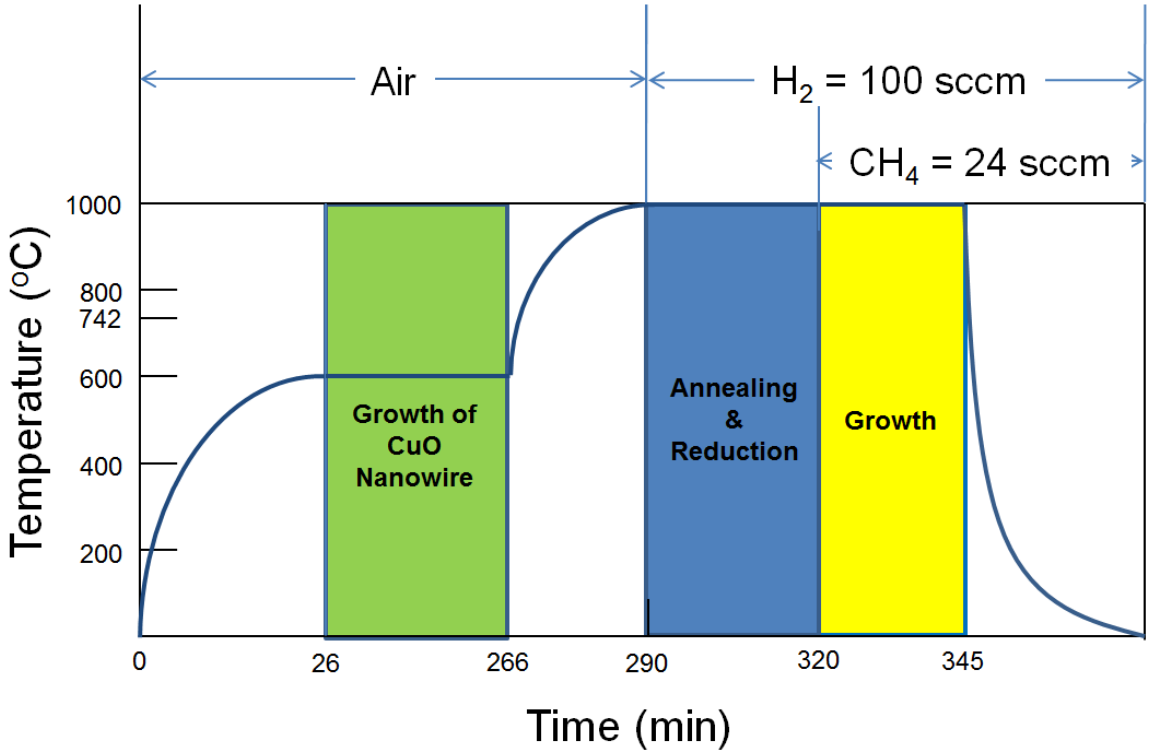

Figure S1. Schematic diagram of the cyclic process for the growth of CuO, reduction of CuO, and the growth of graphene on the surface of reduced Cu by CVD.

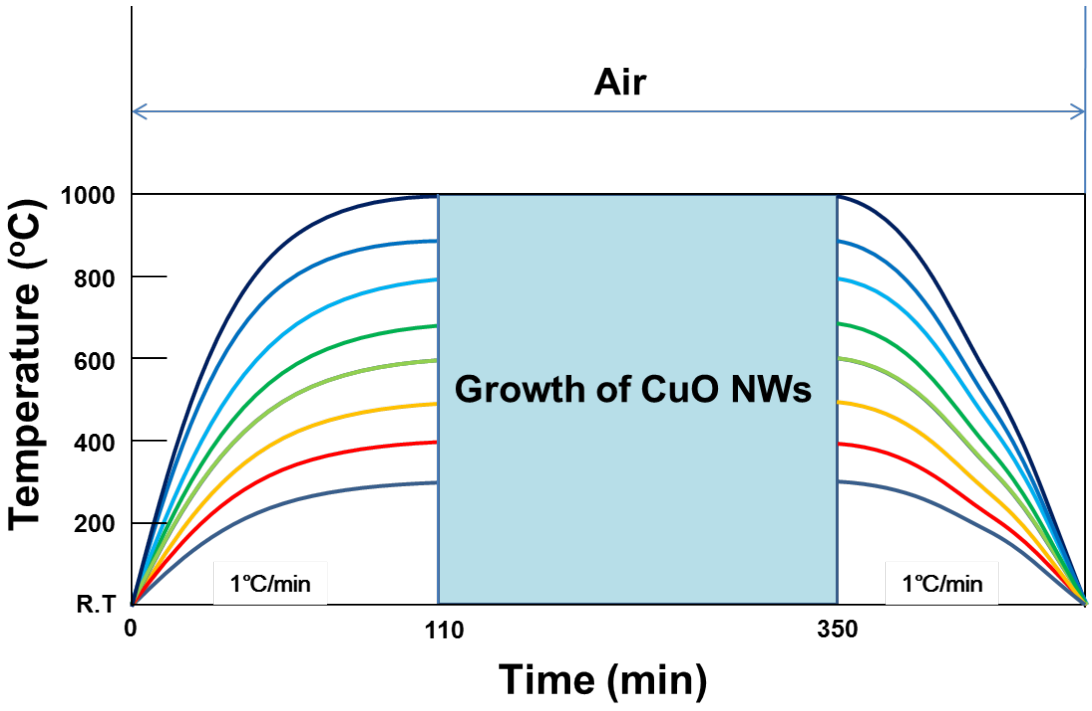

Figure S2. Schematic diagram of the process for the thermal oxidation of Cu foil.

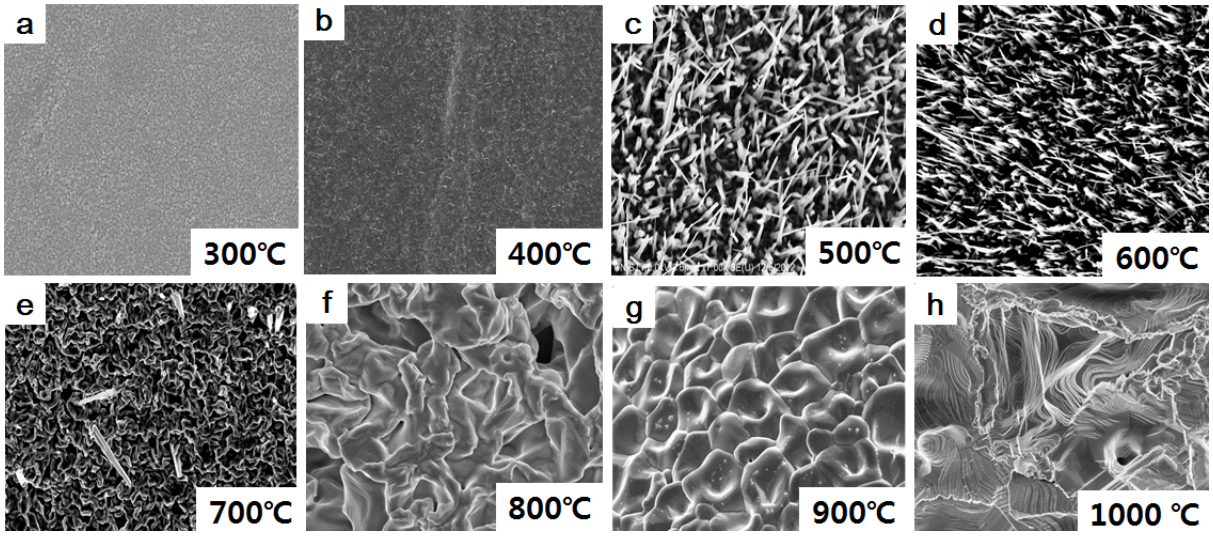

Figure S3. SEM images of CuO grown at various temperatures in air conditions a) 300 °C, b) 400 °C, c) 500°C, d) 600 °C, e) 700 °C, f) 800 °C g) 900 °C, and h) 1000 °C.

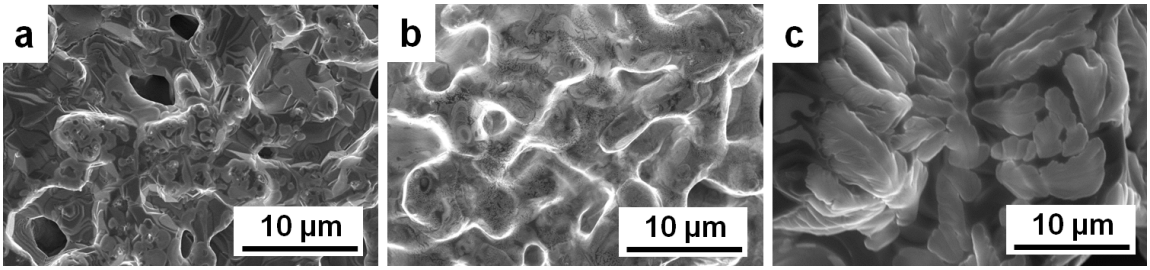

Figure S4. SEM images of Cu reduced from CuO annealed at 800°C for 4hrs, at 1000 °C under a hydrogen condition for various durations of annealing time: a) 1min, b) 10 min, and c) 30 min.

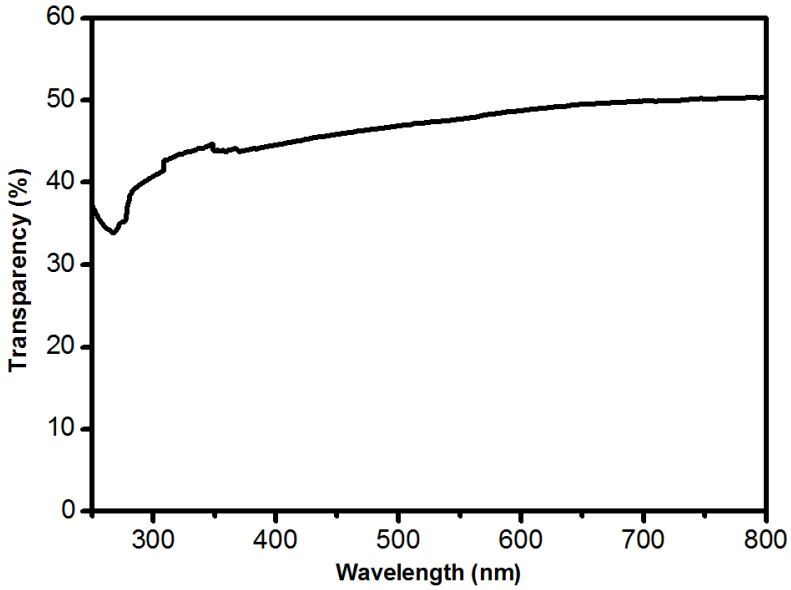

Figure S5. UV-vis spectrum of lotus leaf-inspired 3D graphene.

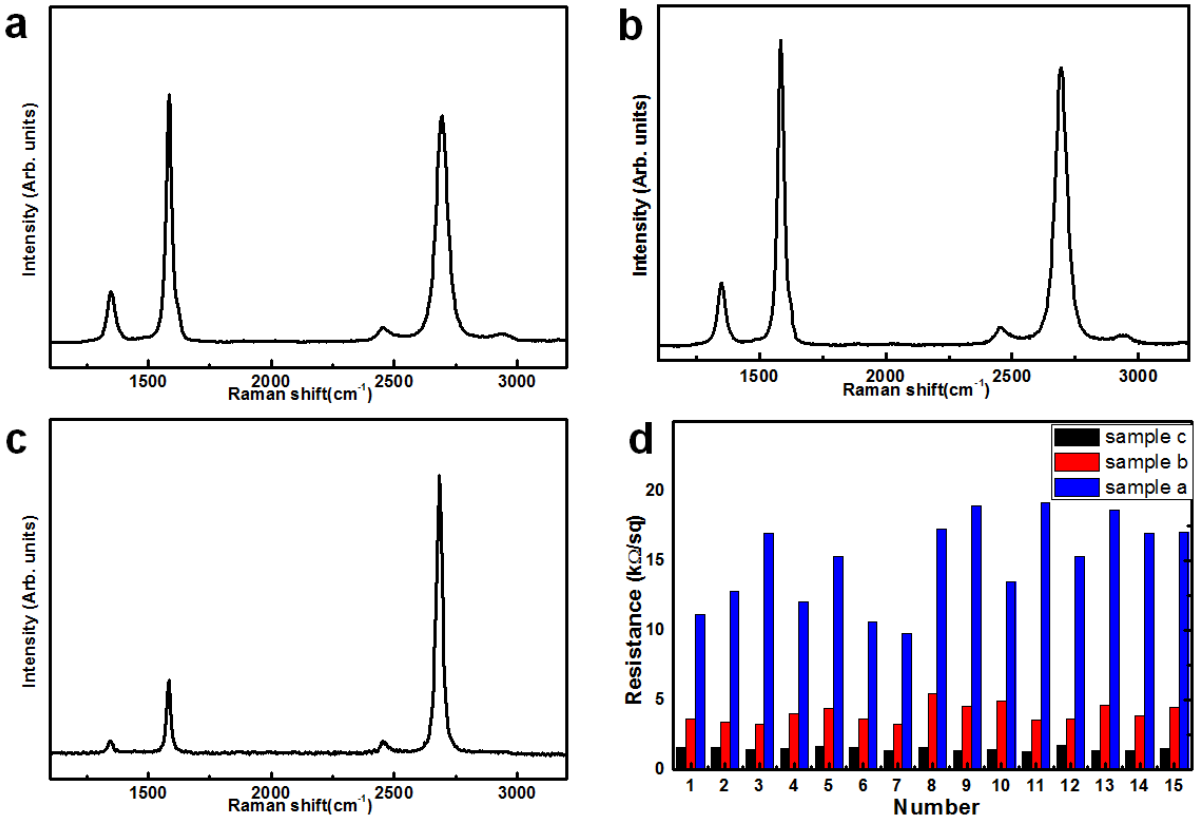

Figure S6. Raman (a-c) and conductivity (d) data of 3D graphene samples with the morphology shown in Figures 2a, 2b, and 2c. The sheet resistance of the samples (a), (b), and (c) was measured to be 15.0, 4.1, and 1.45 kΩ/□.