Electronic supplementary file for the manuscript

"Hollow SnO_2@carbon core-shell spheres stabilized on reduced graphene oxide for High-Performance Sodium-Ion Batteries"

Figure S1 and S2 shows the transformation of 2-D diazonium grafted graphene oxide into 3-D graphene-CNT with iron and cobalt catalysts, respectively.

Figure S3 TGA of SnO_2@C-rGO.

Figure S4 Representative SEM micrograph of SnO_2-rGO

Figure S5 In-lens and corresponding back-scatter SEM image of SnO_2@C-rGO after 200 cycles.

Materials and methods:

Graphene oxide prepared by modified Hummer's method using high purity expandable graphite purchased from Samjung C & G, Korea. Reagent grade tin oxalate and 4-methoxybenzene-diazonium-tetrafluoroborate were purchased from Aldrich and were used as received. Microwave irradiation was carried out in a domestic microwave oven manufactured by Daewoo Korea, Model number: KR-B202WL with output power of 700W operating at 2450 MHz. Morphological characterizations, SEM and TEM, were recorded on FE-SEM, Nova NanoSEM 230 FEI operating at 5kV (no metal coating was applied to the samples) and Talos F200X microscope operating at 200 kV, respectively. Raman spectra were recorded on (LabRAM HR UV/vis/NIR Horiba Jobin-Yvon, France) and samples were chemically analyzed by X-ray photoelectron spectroscopy (Sigma Probe Thermo VG spectrometer using Mg Kα X-ray sources). The XPS spectra were curve fitted with a mixed Gaussian-Lorentzian shape using the freeware XPSPEAK version 4.1. Surface area and porosity were measured by Nitrogen adsorption and desorption isotherms at 77K using a BEL Japan Inc.

Electrochemical tests were conducted using CR2032 coin-type test cells assembled in argon- filled glove box. Working electrodes were prepared with active materials and poly(acrylic acid) as the binder (mass ratio of 85: 15) were added to ethanol and mixed into a homogeneous slurry. The slurry was cast on a fresh glass plate cleaned with piranha solution and dried at 100 °C in vacuum for 5 h. The coin cells were assembled with pure sodium foil as counter electrode, a glass fiber as separator, 1M $NaClO_4$ in ethylene carbonate/propylene carbonate (1:1 v/v) as electrolyte. Galvanostatic charge-discharge cycling tests were performed using an WBCS 3000, Won-A-Tech, Korea battery testing system in the voltage range between 0.001 - 3 V.

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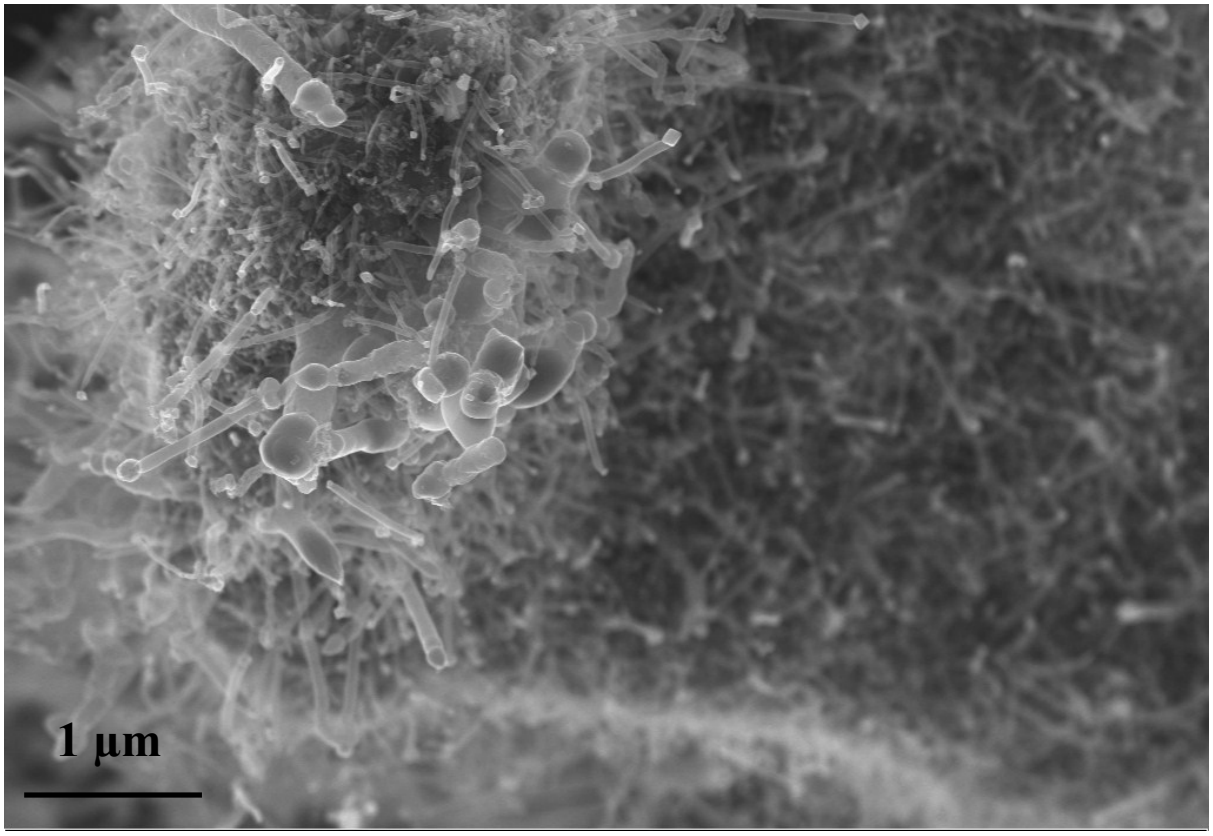

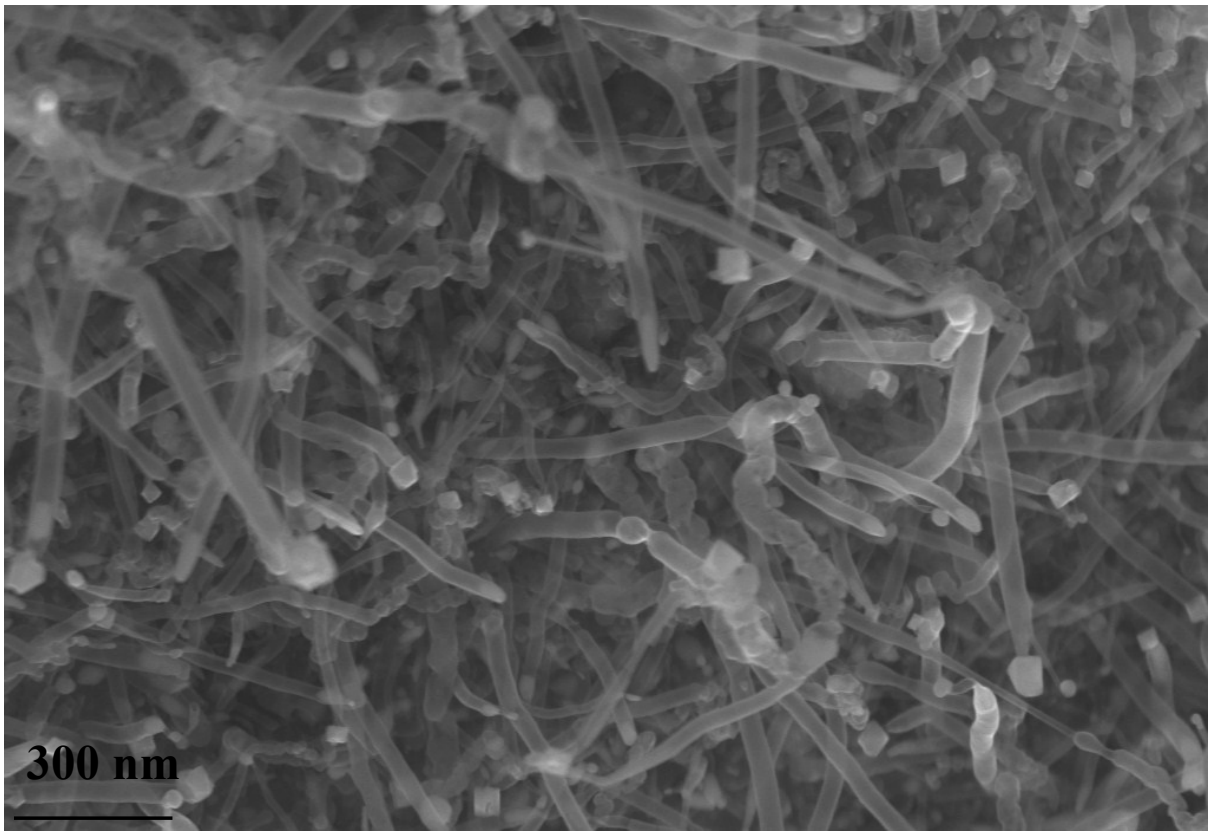

Figure S1

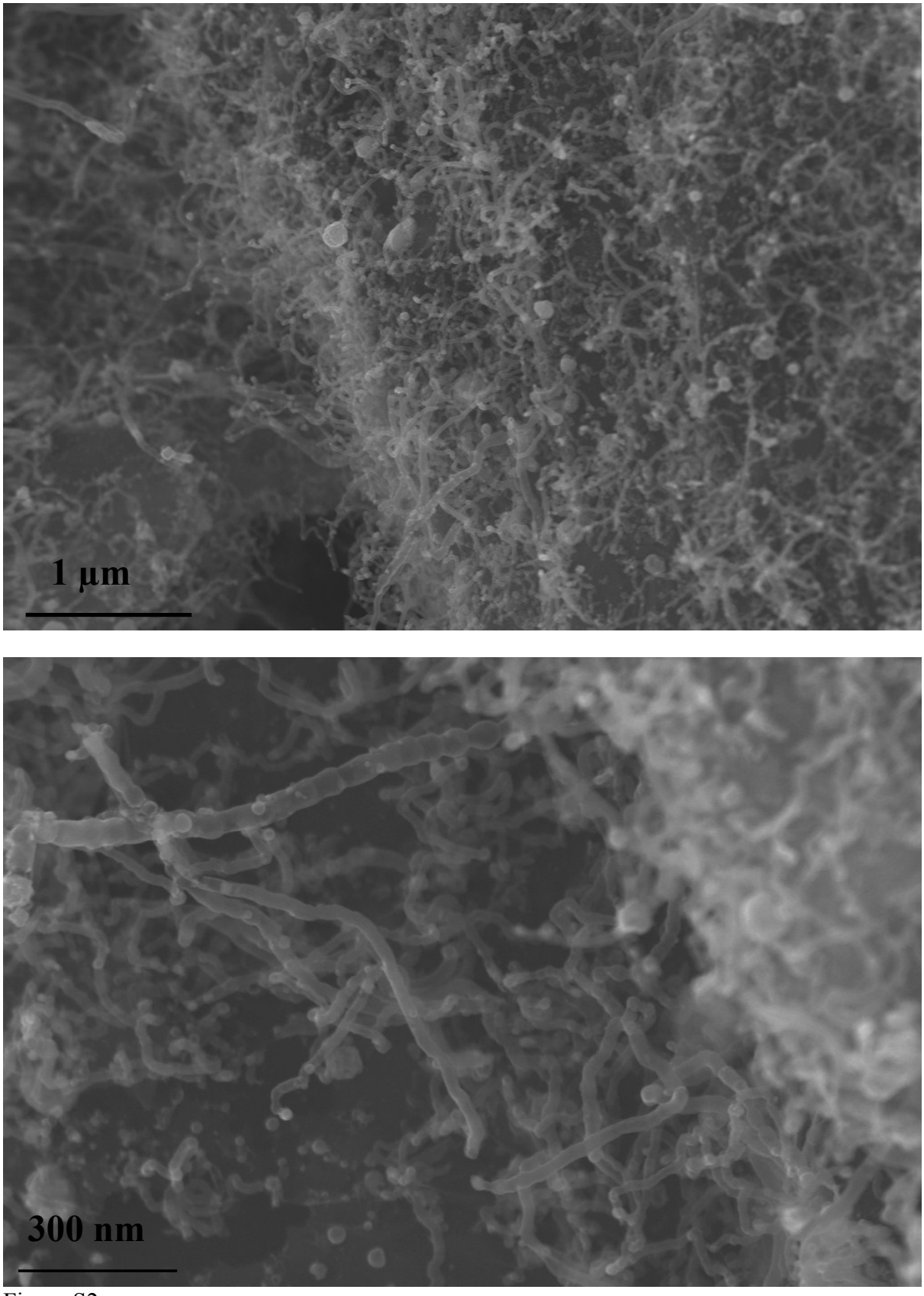

Figure S2

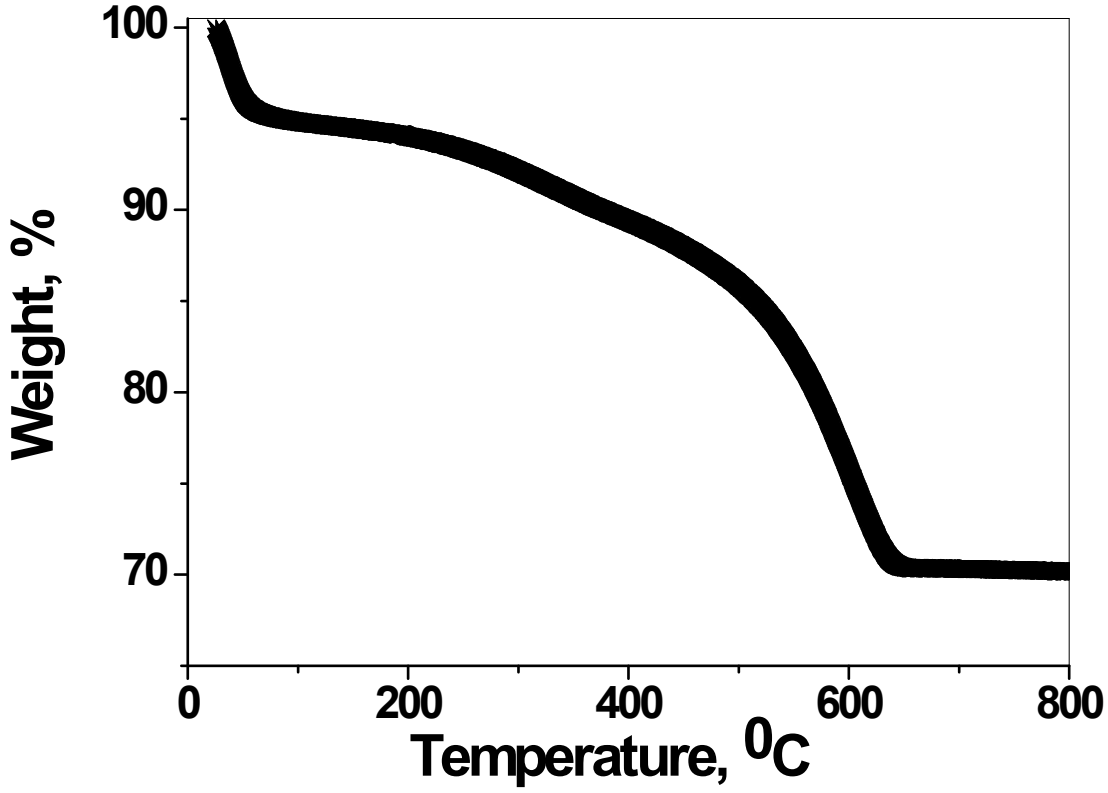

Figure S3

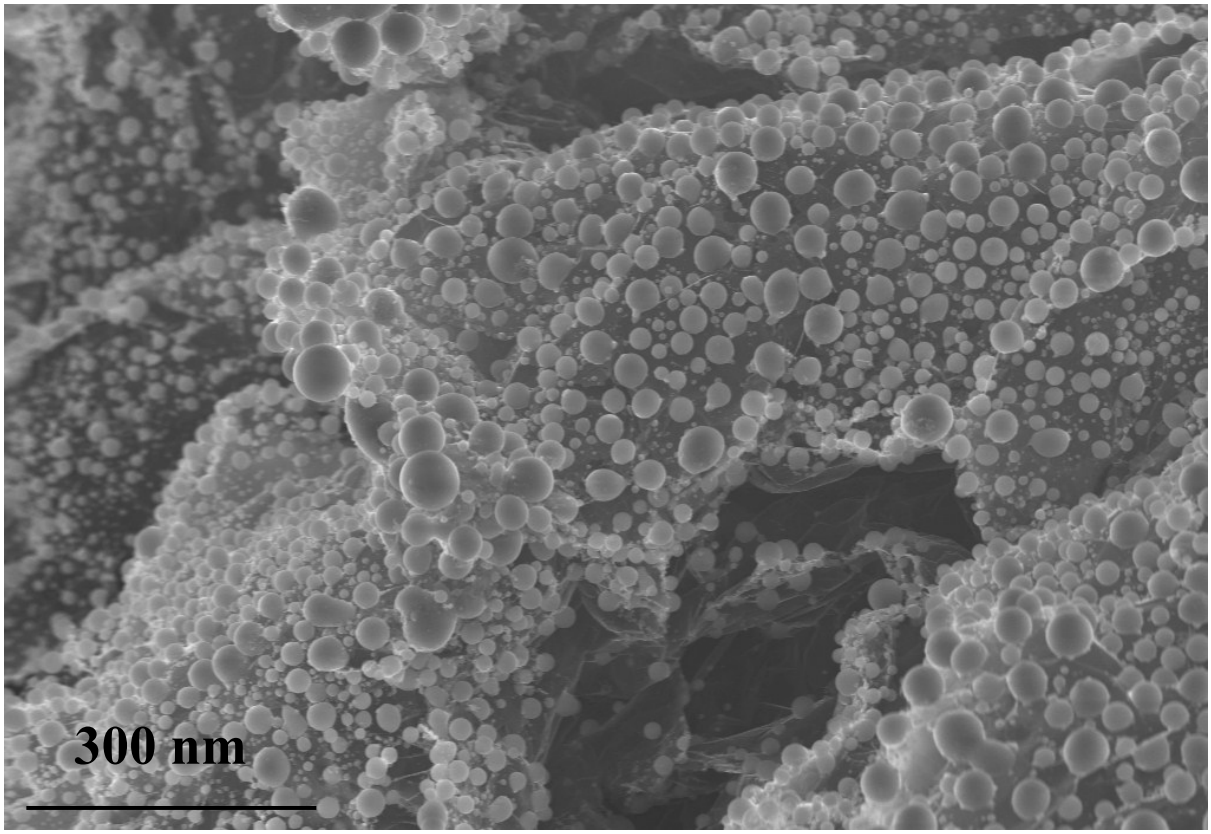

Figure S4

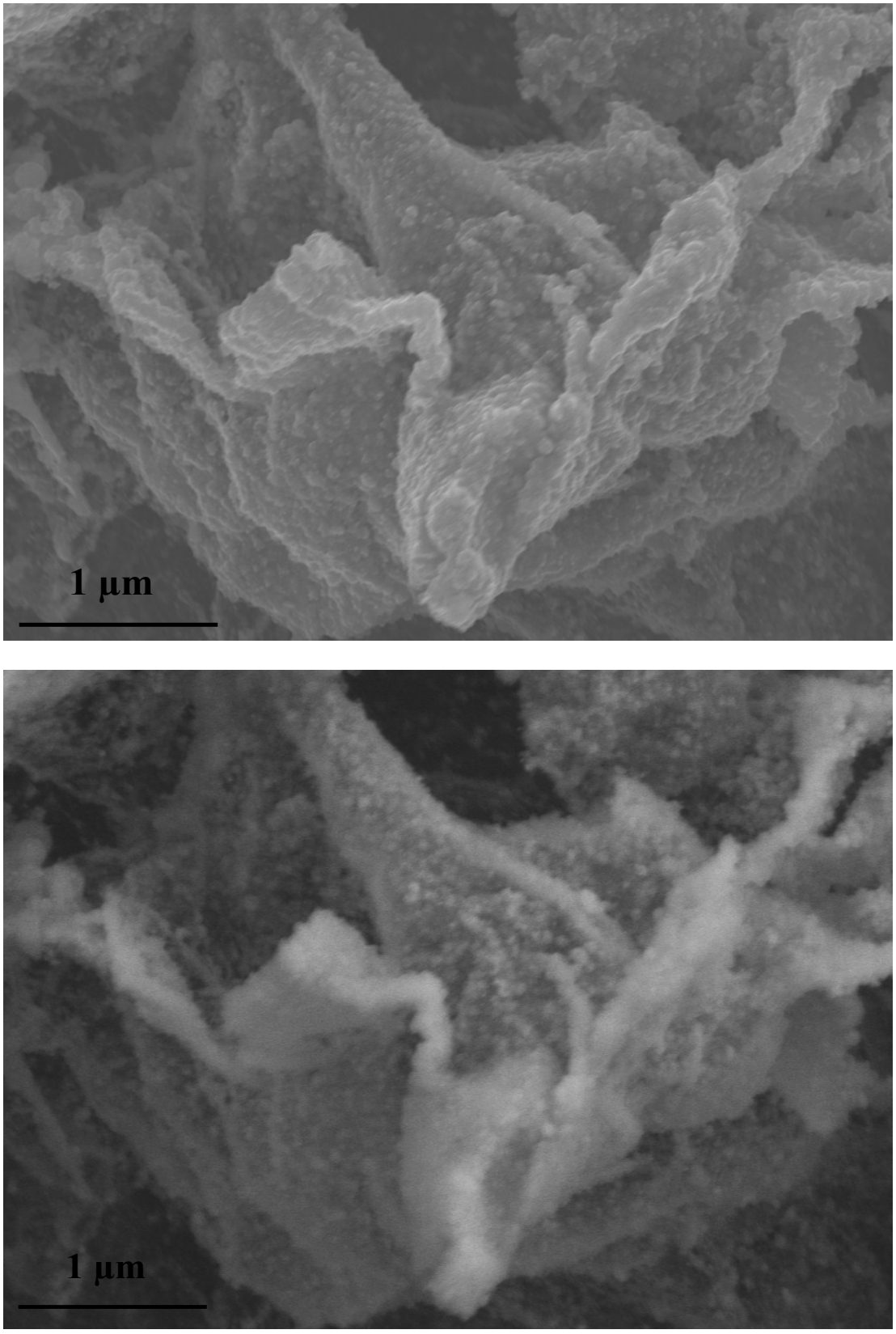

Figure S5