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Supplementary material to

High-performance supercapattery with nanotube-TiO_2/carbon nano tubes anode and coconut-shell-derived activated carbon cathode

Thi Thu Trang Nguyen[1,✉], Thi Nhu Nguyet Pham[2,3], Hoang Anh Nguyen[2,3], Thi Nhu Quynh Nguyen[2,3], Nguyen Thanh Le Huynh[2,3,✉], Van Viet Pham[4], Hoang Nguyen[2,3], Viet Hai Le[2,3], Thi Thu Trang Nguyen[5], Thi Thom Nguyen[1], Thi Nam Pham[1], Dai Lam Tran[1,6], Trong Lu Le[1]

[1]*Institute for Tropical Technology, Vietnam Academy of Science and Technology, Hanoi, Vietnam*
[2]*Vietnam National University Ho Chi Minh City, Vietnam*
[3]*University of Science, Ho Chi Minh City, Vietnam*
[4]*HUTECH University, Ho Chi Minh City, Vietnam*
[5]*University of Education, Ho Chi Minh City, Vietnam*
[6]*Graduate University of Science and Technology, Vietnam Academy of Science and Technology, Hanoi, Vietnam*

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NT-TiO_2/CNTs electrode preparation process

The working electrode is a mixture of NT-TiO_2/CNTs composite, Acetylene Black, and PVdF with a percentage of 80:15:5 by mass. The electrode membrane preparation process consists of 4 steps:

- Step 1: Weigh 240.0 mg of NT-TiO_2/CNTs composite and 45.0 mg of acetylene black. Put the mixture into a mortar and grind until the mixture is homogeneous. Then, add about 72 µL of PVDF/NMP colloidal solution with a concentration of 70 mg mL^{-1} and mix until the mixture is homogeneous. Add more NMP until the mixture has the appropriate viscosity.
- Step 2: Fix the graphite foil; the above mixture is spread evenly on the graphite foil.
- Step 3: Use a rolling ruler to pull a straight line from top to bottom to obtain a membrane with a thickness of 200 ± 10 µm.
- Step 4: Dry the electrode in a vacuum oven at 120 °C for 12 hours.

Coconut-shell derived activated carbon AC electrode preparation process

The coconut-shell-derived activated carbon (AC) was purchased from TRABACO LTD, Vietnam, while the CNTs were supplied by NTherma Corporation (USA). Before the AC and CNTs were prepared for the electrode, they were pre-treated following our process in the previous publications [1-3].

A carbon slurry was prepared by mixing coconut-shell derived AC, treated carbon nanotubes (CNTs), and poly(vinylidene fluoride-co-hexafluoropropylene) (PVF-HFP) binder (Sigma-Aldrich) with

1-methyl-2-pyrrolidinone (NMP, Sigma-Aldrich) solvent (the weight ratio of 90:5:5) to form a homogeneous paste. Aluminum foils (sourced from Mineral Seal Corporation, USA) were cleaned by rinsing three times with ethanol and acetone, then drying at 120 °C for an hour under a vacuum. The prepared carbon slurry was then uniformly coated onto the graphite foil using the doctor-blade method. The composite layer was controlled to a thickness of approximately 200 ± 10 µm to ensure consistency across samples. The AC electrode was dried under vacuum at 120 °C overnight.

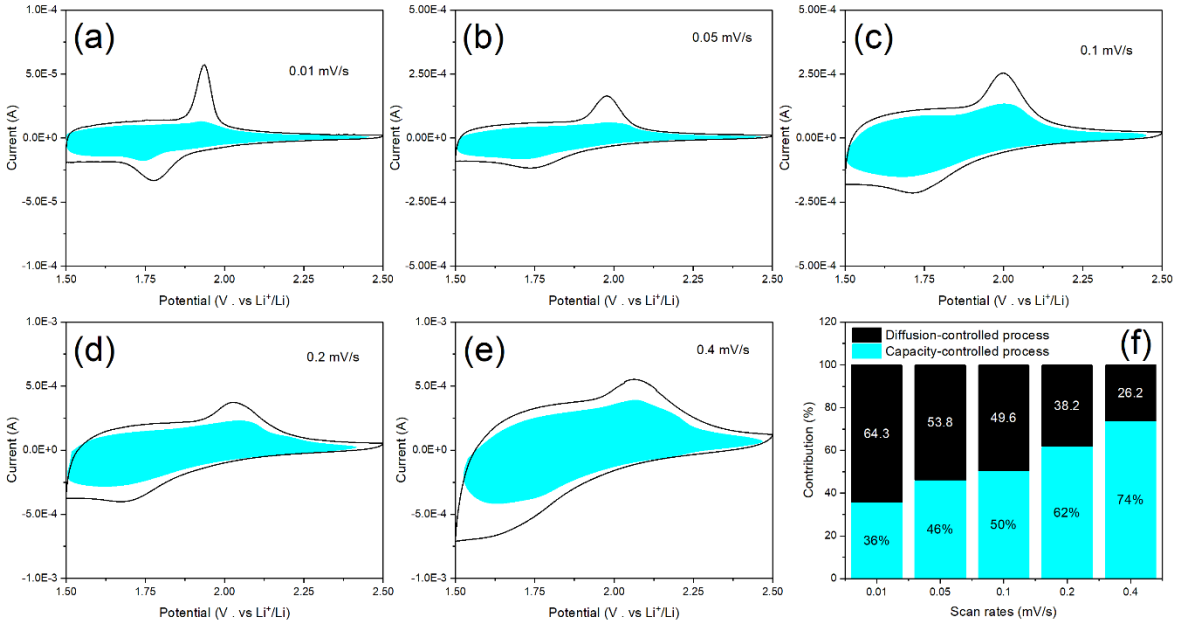

Figure S1. *(a-e) Capacitive and diffusion currents contributing to charge storage of pristine NT-TiO_2 at various scan rates and (f) charge contributions at 0.01 mV s^{-1} following Dunn method*

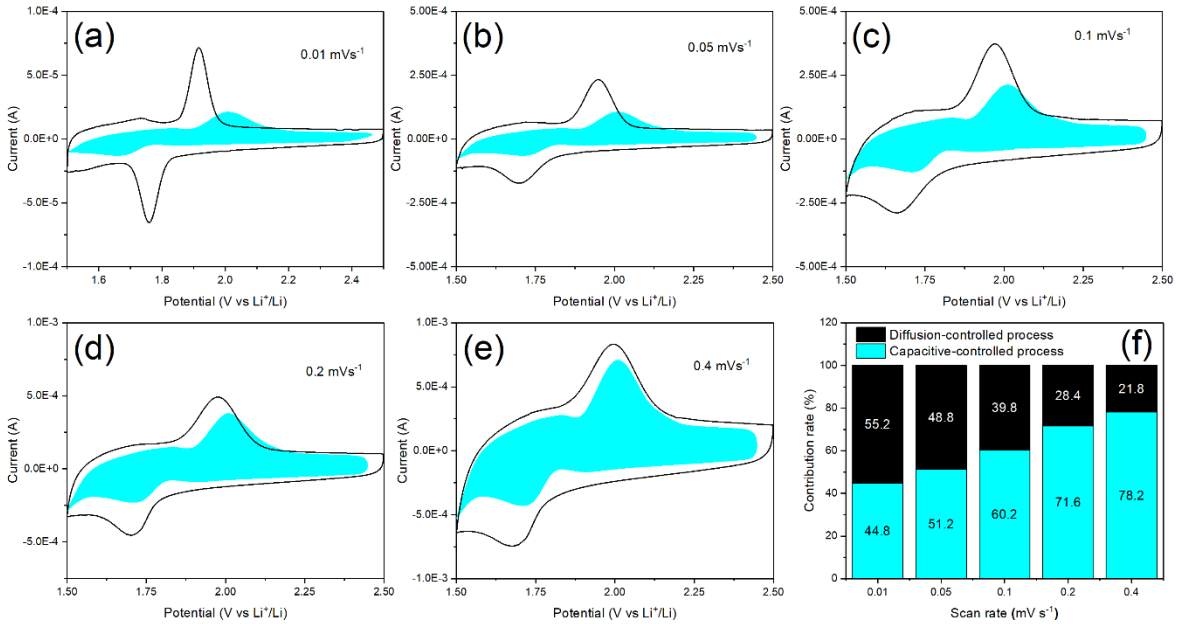

Figure S2. *(a-e) Capacitive and diffusion currents contributing to charge storage of NT-TiO_2/CNTs-1 composites at various scan rates and (f) charge contributions at 0.05 mV s^{-1}*

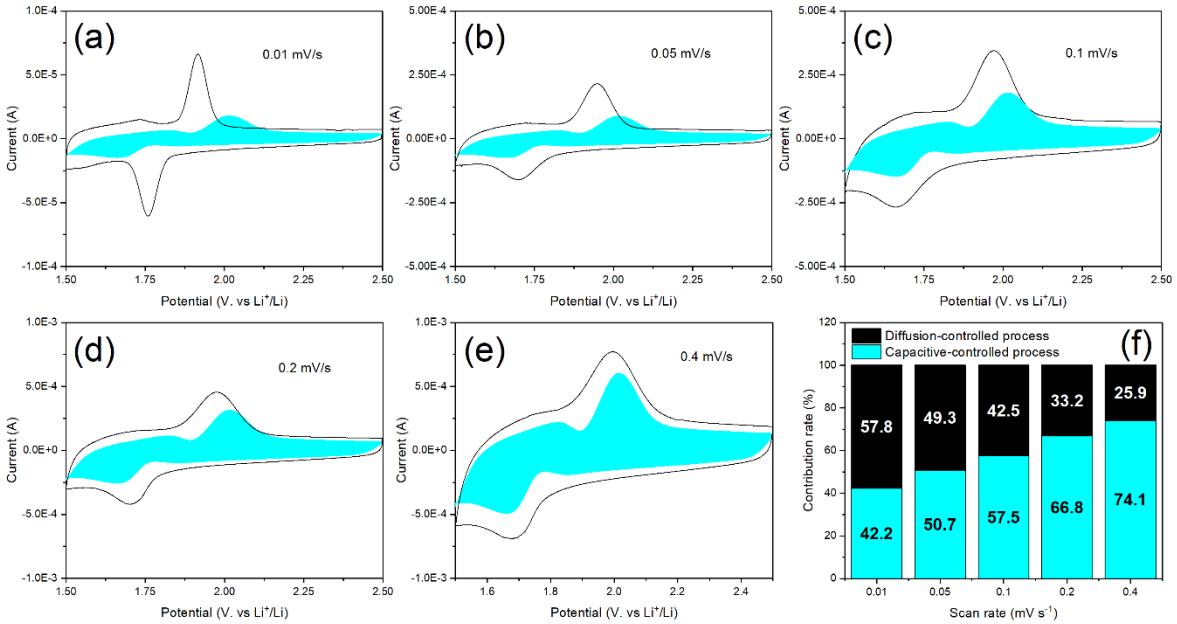

Figure S3. *(a-e) Capacitive and diffusion currents contributing to charge storage of NT-TiO_2/CNTs-3 composite at various scan rates and (f) charge contributions at 0.1 mV s^{-1}*

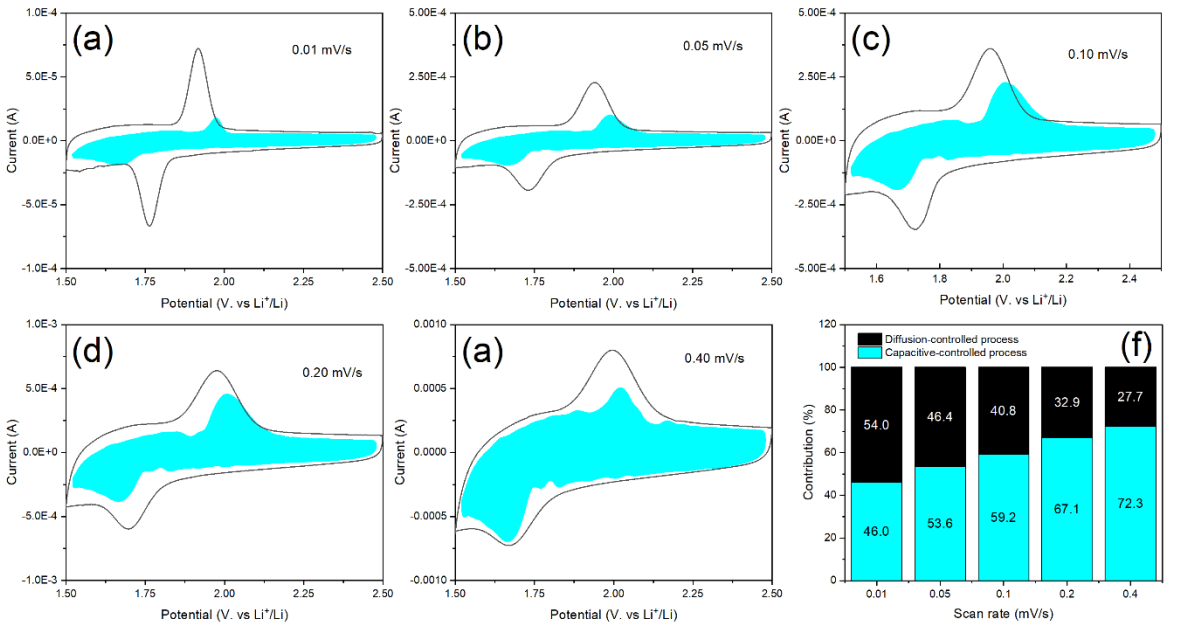

Figure S4. *(a-e) Capacitive and diffusion currents contributing to charge storage of NT-TiO_2/CNTs-5 composites at various scan rates and (f) charge contributions at 0.2 mV s^{-1}*

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