

Supporting Information

Electrochemical Synthesis and Fast Electrochromics of Poly(3,4-ethylenedioxythiophene) Nanotubes in Flexible Substrate

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The detailed structures of the bottom gold electrodes.

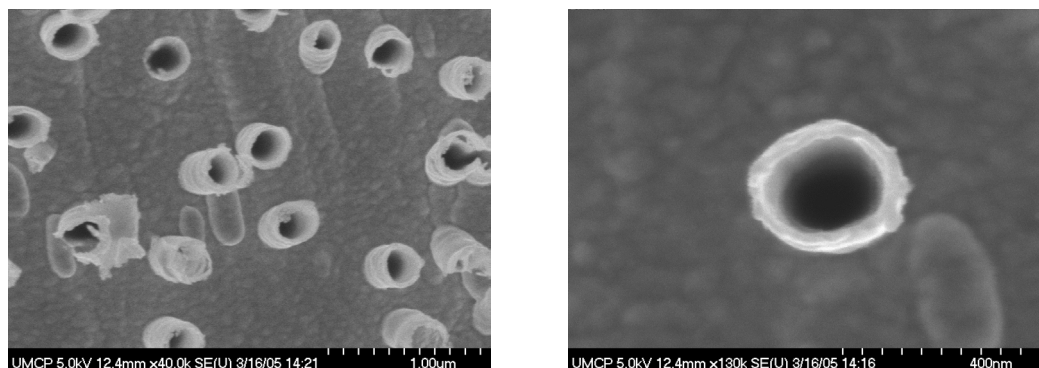
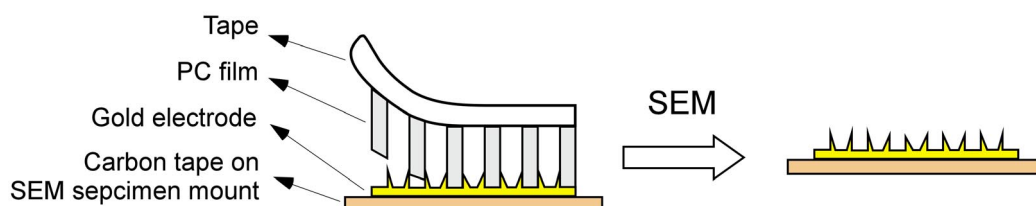


Figure S1. Images of scanning electron microscopy (SEM) for the bottom gold electrodes. One side of the polycarbonate (PC) film (220-nm pore diameter) was sputter-coated with a thin layer of gold as working electrode for the electrochemical synthesis of PEDOT nanotubes in each of the membrane pores. The gold-coated PC film was soaked in 2 M NaOH solution for a few minutes to facilitate the removal of the PC film from the coated gold layer. After rinsing the gold-coated film with water, the gold-coated side was attached on a specimen mount for SEM using a carbon tape. The PC film was carefully peeled off and separated from the coated gold layer using a highly adhesive tape as shown below. The SEM images were taken from the exposed gold layer.



Scheme S1. Schematic of SEM sampling for gold bottom electrodes by peeling off PC membrane.

Electrochemical synthesis of PEDOT nanotubes in the aqueous solution.

Duvail *et al.* synthesized electrochemically PEDOT nanowires, not nanotubes, in an aqueous solution using a PC membrane.¹¹ We could synthesize PEDOT nanotubes by reducing the electropolymerization time to 100 s in the same condition [0.07 M sodium dodecylsulfate (SDS), 0.1 M LiClO₄, and 0.05 M EDOT] as shown in Fig. S2. Nanowires were obtained by increasing polymerization time to 400 s. Furthermore, in the membranes with smaller pore diameter of 75 – 150 nm,¹¹ the nanowires are expected to be synthesized more easily than in the membrane with wider pore diameter of 220 nm.

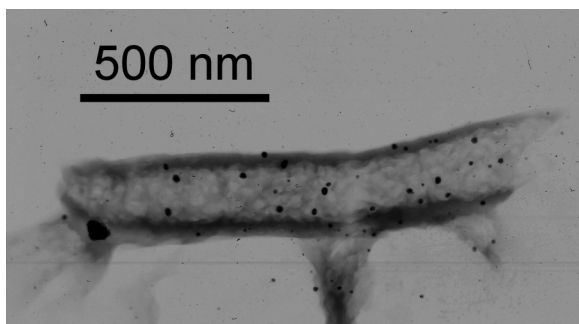


Figure S2. TEM images of PEDOT nanotubes polymerized at the constant potential of +0.8 V for 100 s in the aqueous solution of 0.07 M in SDS, 0.1 M in LiClO₄, and 0.05 M in EDOT using a PC membrane (220 nm).