Supporting Information

Controlled Polymerization of Aniline against Templating Oxide Nanostructures

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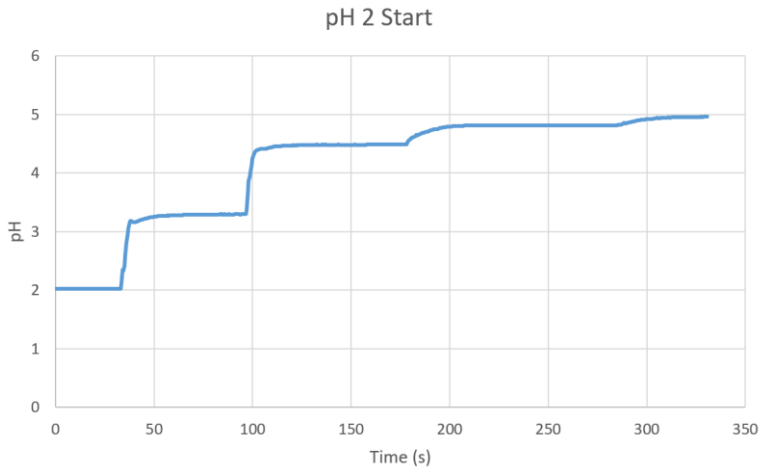


Figure S1. Change of solution pH value as aniline added to the dispersion of MnO_2 nanostructures at 30, 90, 180, 270 s. The jump of pH value indicates the consumption of protons as aniline being oxidized by MnO_2.

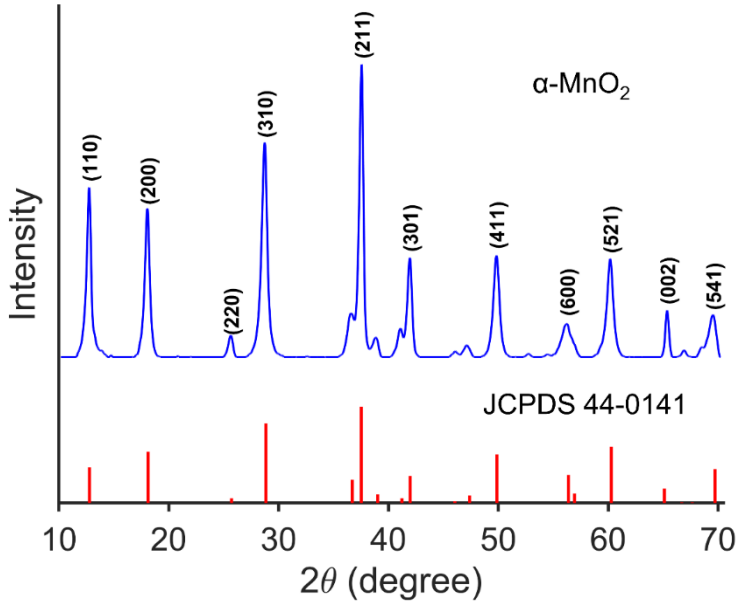


Figure S2. XRD pattern of the synthesized MnO_2 nanotubes.

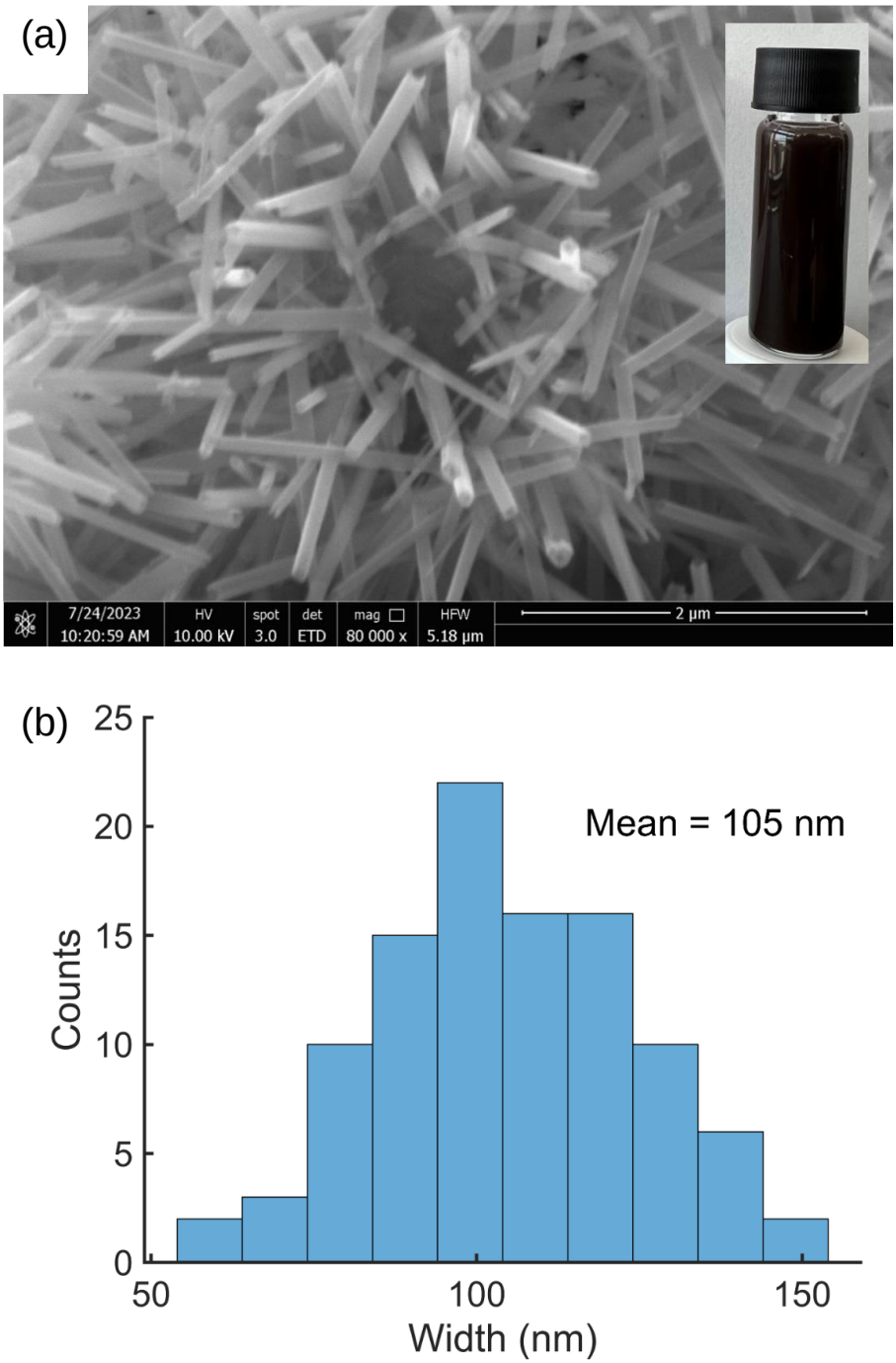


Figure S3. (**a**) Scanning electron microscopy (SEM) image of the synthesized MnO_2 nanotubes. The nanotubes standing out-of-substrate show the square cross sections and hollow interiors. The inset is a photo of an aqueous dispersion of the MnO_2 nanotubes. (**b**) Statistic histogram of the lateral dimensions of individual MnO_2 nanotubes.

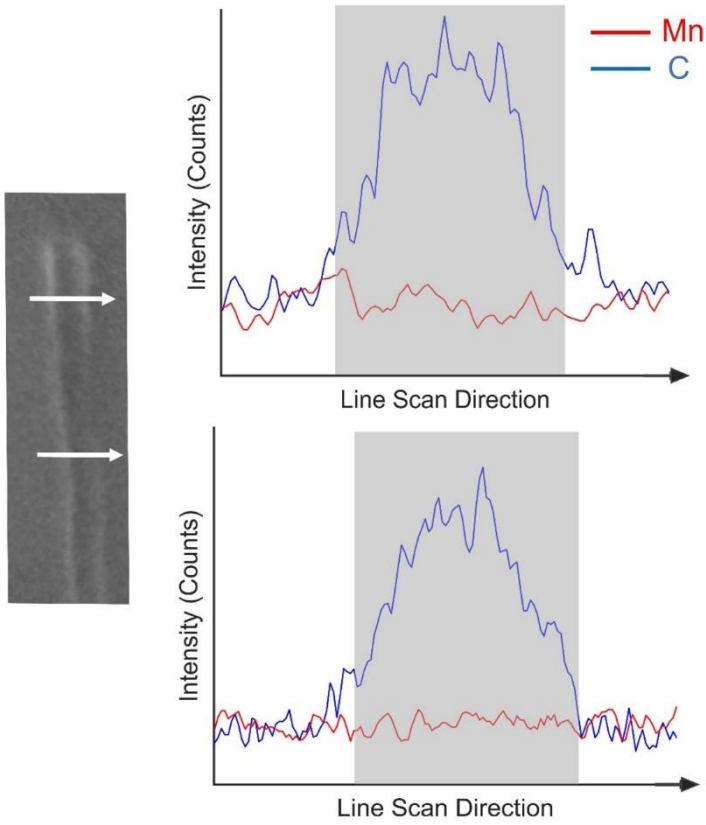


Figure S4. Line-scan EDS profiles across a PANI nanotube (formed from 10-minute reaction as shown in Figure 2d) at different locations. The near-zero signals of Mn regardless of position confirm the complete consumption of MnO_2 throughout the entire nanotube. The gray boxes highlight the boundaries of the nanotube along the scan traces.

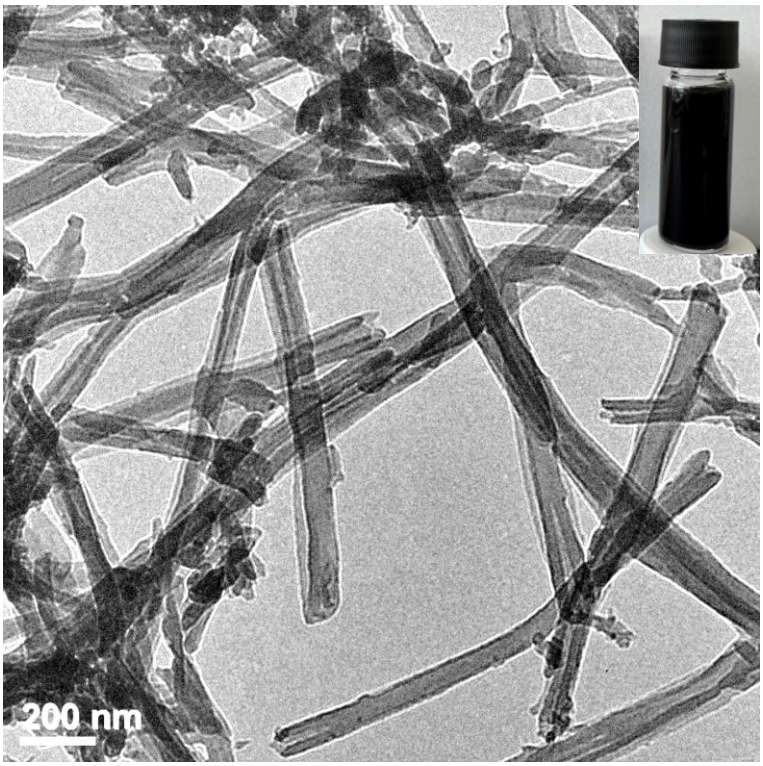


Figure S5. Transmission electron microscopy (TEM) image of the synthesized PANI nanotubes. The bended curves along their longitudinal directions indicate their mechanical flexibility.

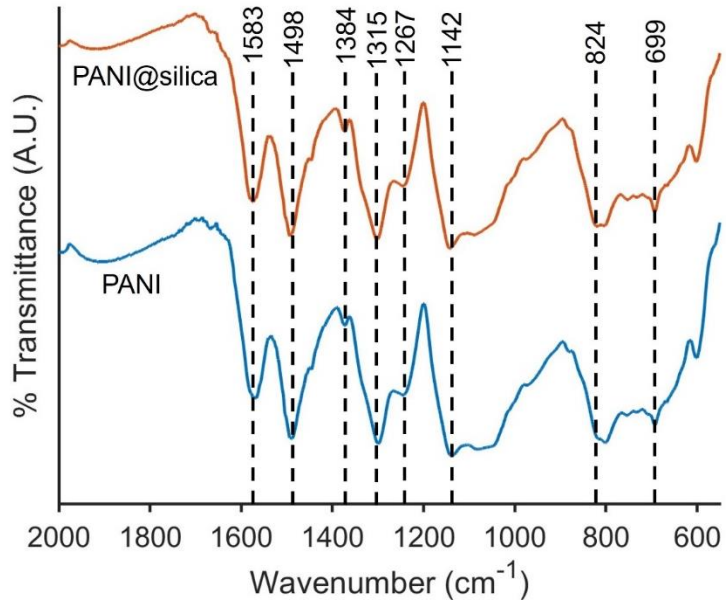


Figure S6. FTIR spectrum of the as-synthesized PANI nanotubes as shown in Figure 2d and PANI@silica nanotubes as shown in Figure 5.

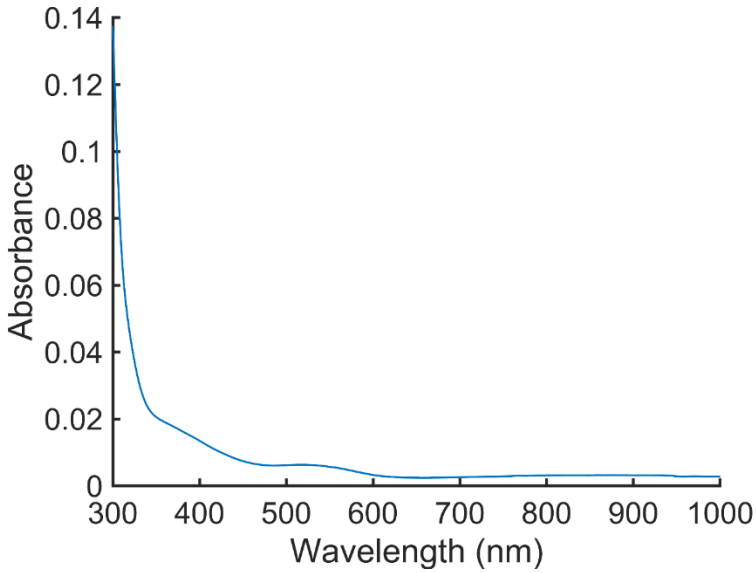


Figure S7. Absorption spectrum of the supernatant after complete reaction of the MnO_2 nanotubes. The absorbance beyond 500 nm, where optical absorption of the emeraldine PANI locates, is lower than 0.01, which is less than 2% of the peak absorption of the PANI nanotube dispersion. Therefore, it is reasonable to ignore the influence of resulting Mn^{2+} on the extinction spectra during the reaction. .

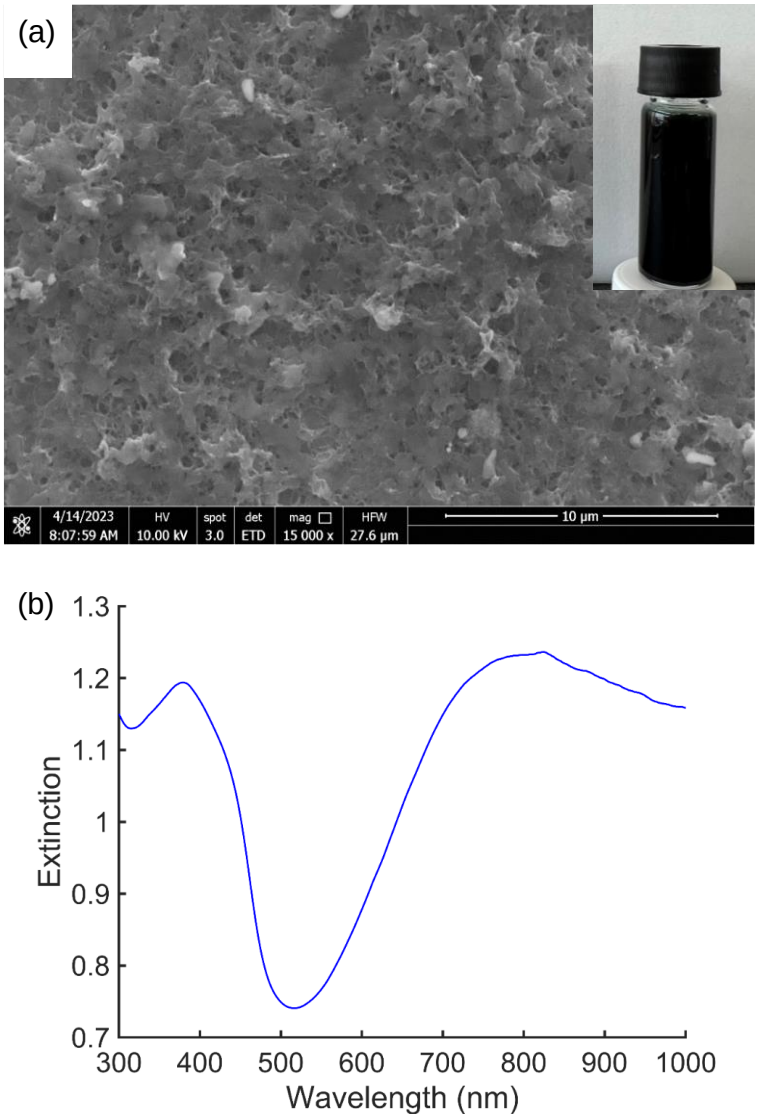
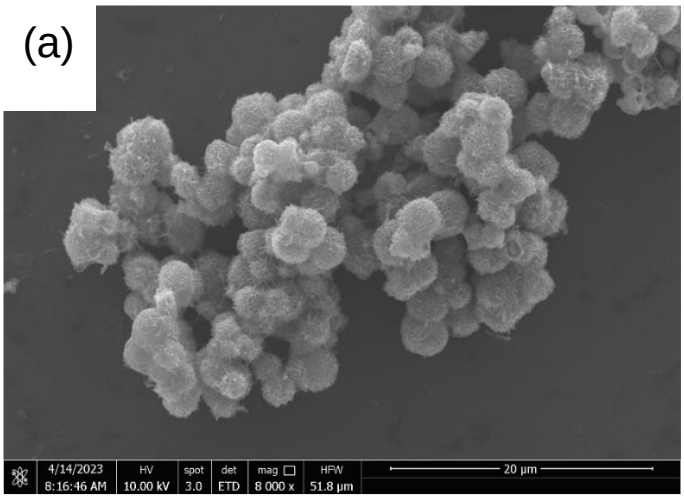


Figure S8. (**a**) TEM image of PANI synthesized using APS. The inset is the photo of the PANI dispersion. (**b**) Extinction spectrum of the PANI dispersion. The concentration of aniline units is same as that used in the synthesis of PANI nanotubes.



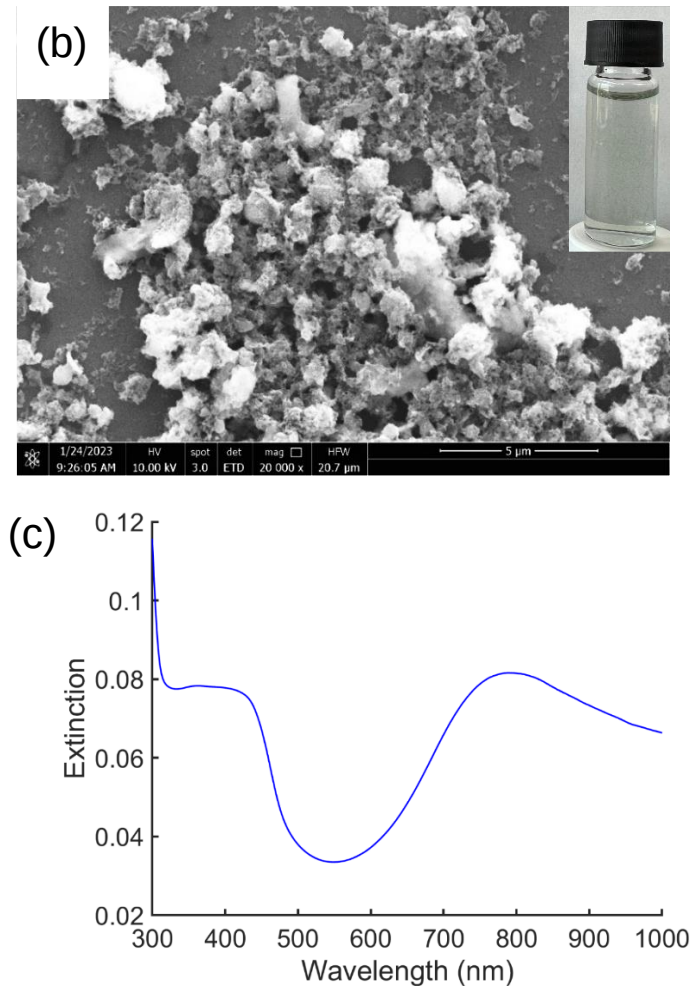


Figure S9. (**a**) SEM image of MnO_2 spherical shells with rough surfaces. (**b**) TEM image of PANI synthesized from reaction with the MnO_2 shells. The inset is the photo of the PANI dispersion. (**c**) Extinction spectrum of the PANI dispersion. The concentration of aniline units is same as that used in the synthesis of PANI nanotubes.

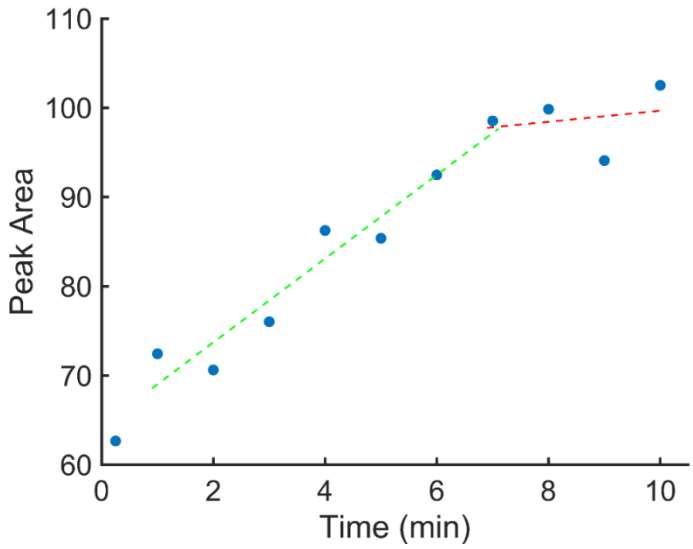


Figure S10. Time-dependent integrated area of the absorption beyond the valley points in Figure 4a. The integration was processed using the line connecting the valley point around 400 nm and the data point at the longest wavelength (i.e., 980 nm) in each spectrum.

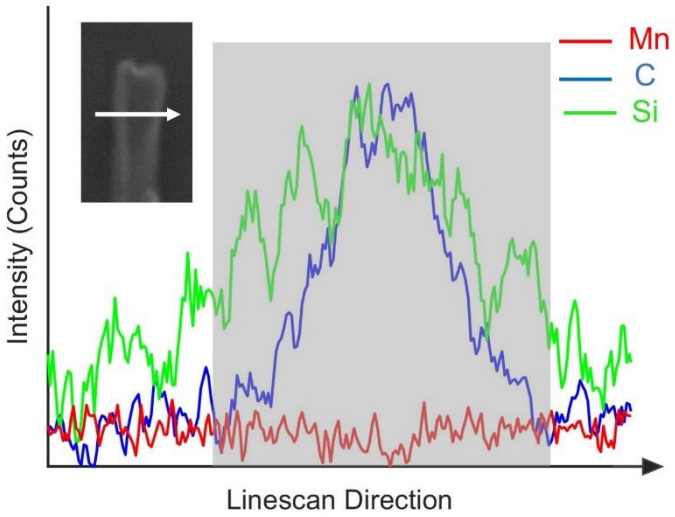


Figure S11. Line-scan EDS profiles of a synthesized PANI@silica core-shell nanotube. The inset represents the SEM image of the PANI@silica nanotube, with an arrow highlighting the scan position and direction. The grey box represents the outer boundary of the nanotube along the scan traces.

Table S1. Reactivity of MnO_2 nanotubes and the resulting PANI phase at different pH of reaction solution.

pH	Reaction	Emeraldine PANI
5	No	No
3	Yes	No
2	Yes	No
1.5	Yes	Yes
≤1	Yes	Yes