

Supporting information for

# Enhancing the Nanomaterial Bio-Interface by Addition of Mesoscale Secondary Features: Crinkling of Carbon Nanotube Films To Create Subcellular Ridges

Xing Xie,<sup>†,#</sup> Wenting Zhao,<sup>‡,#</sup> Hye Ryoung Lee,<sup>§</sup> Chong Liu,<sup>‡</sup> Meng Ye,<sup>†</sup> Wenjun Xie,<sup>||</sup> Bianxiao Cui,<sup>||</sup> Craig S. Criddle,<sup>\*,†</sup> and Yi Cui<sup>\*,‡,⊥</sup>

<sup>†</sup>Department of Civil and Environmental Engineering, Stanford University, 473 Via Ortega, Stanford, California 94305, United States.

<sup>‡</sup>Department of Materials Science and Engineering, Stanford University, 476 Lomita Mall, Stanford, California 94305, United States.

<sup>§</sup>Department of Electrical Engineering, Stanford University, 350 Serra Mall, Stanford, California 94305, United States.

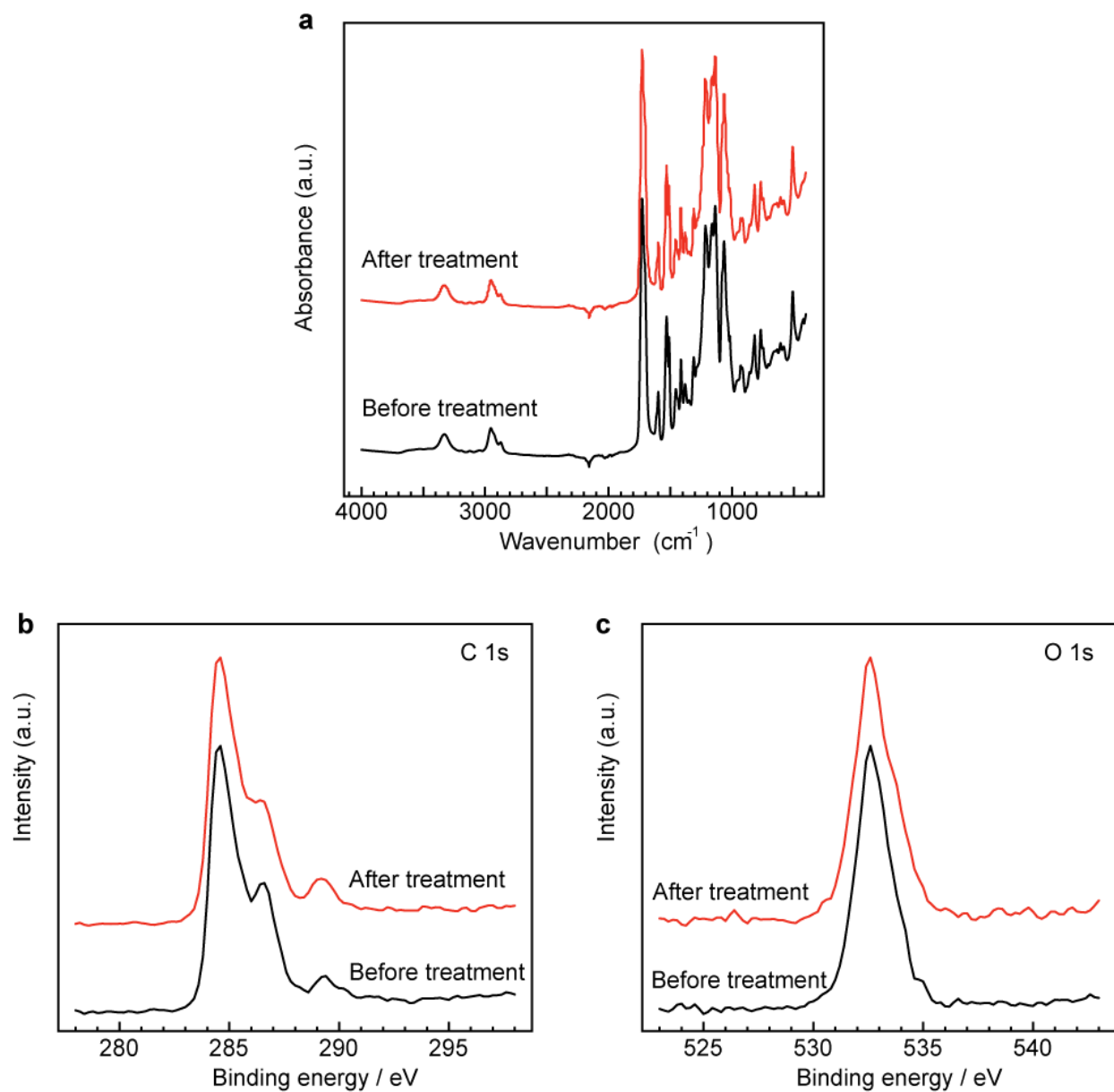
<sup>||</sup>Department of Chemistry, Stanford University, 380 Roth Way, Stanford, California 94305, United States.

<sup>⊥</sup>Stanford Institute for Materials and Energy Sciences, SLAC National Accelerator Laboratory, 2575 Sand Hill Road, Menlo Park, California 94025, United States.

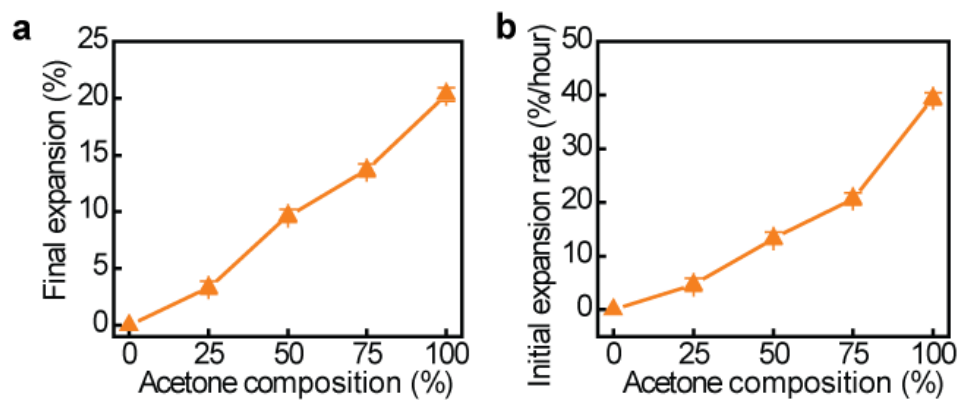
<sup>#</sup>X.X. and W.Z. contributed equally.

\*Address correspondence to [ccriddle@stanford.edu](mailto:ccriddle@stanford.edu), [yicui@stanford.edu](mailto:yicui@stanford.edu).

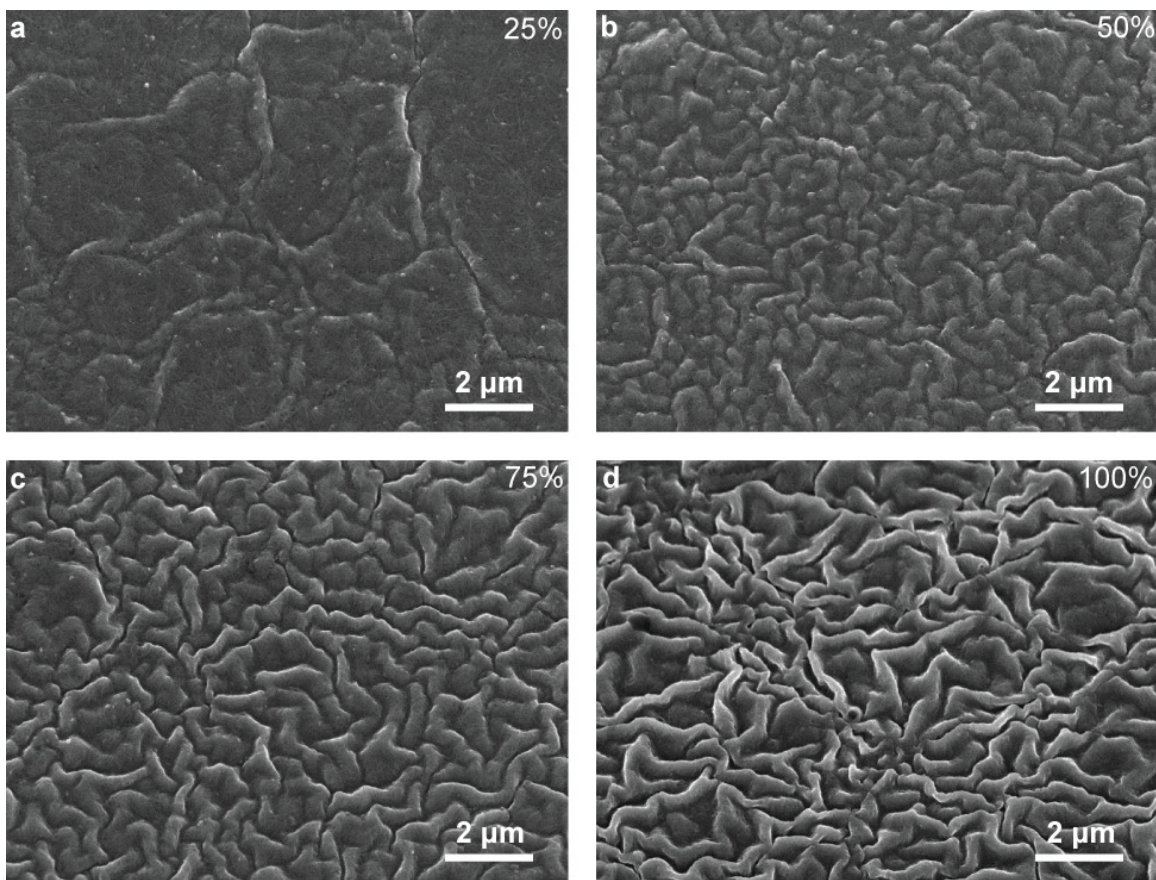
## SUPPLEMENTARY FIGURES



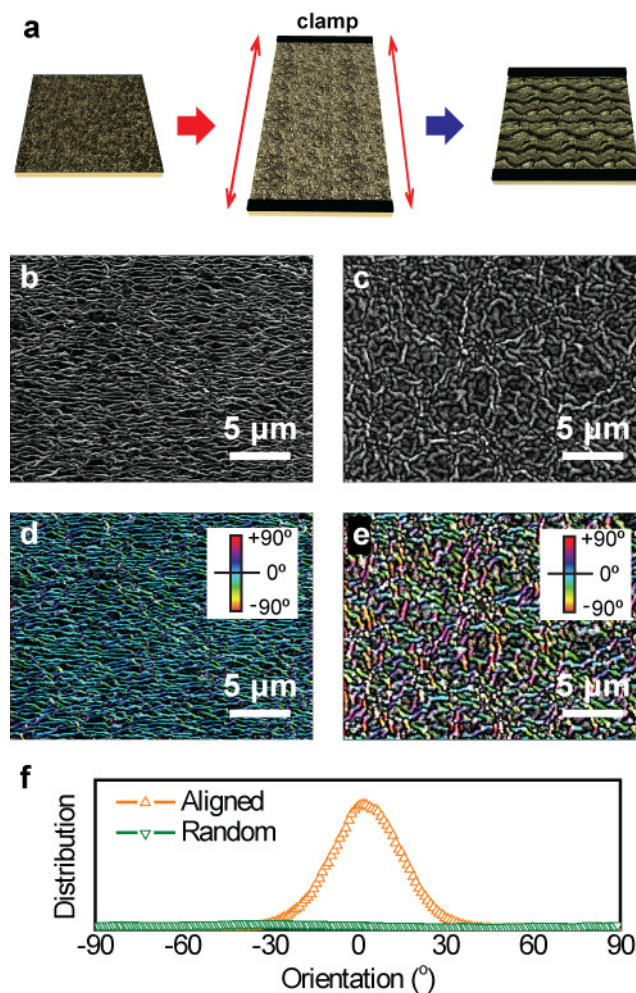
**Figure S1. Surface functional group characterization of mesoscale crinkly carbon nanotube (CNT) thin film created by the swelling-and-shrinking treatment. (a) FT-IR (ATR) spectra; (b and c) XPS spectra.**



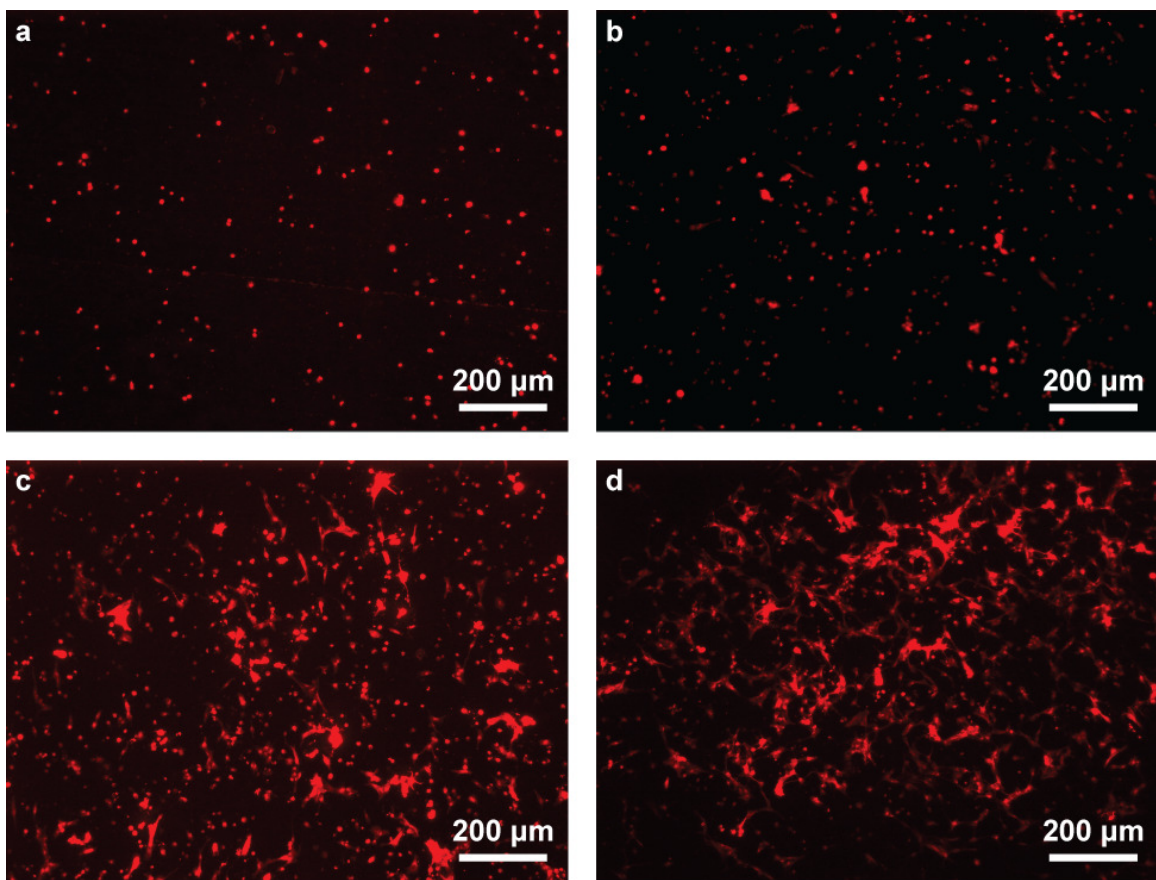
**Figure S2. Final expansions (a) and initial expansion rates (b) of the CNT-coated polyurethane (PU) sheets in acetone-water solutions with varied acetone composition.**



**Figure S3. SEM images of mesoscale crinkly CNT thin film created by the swelling-and-shrinking process.** The acetone compositions applied during expansion are noted in the top-right corner of the images.

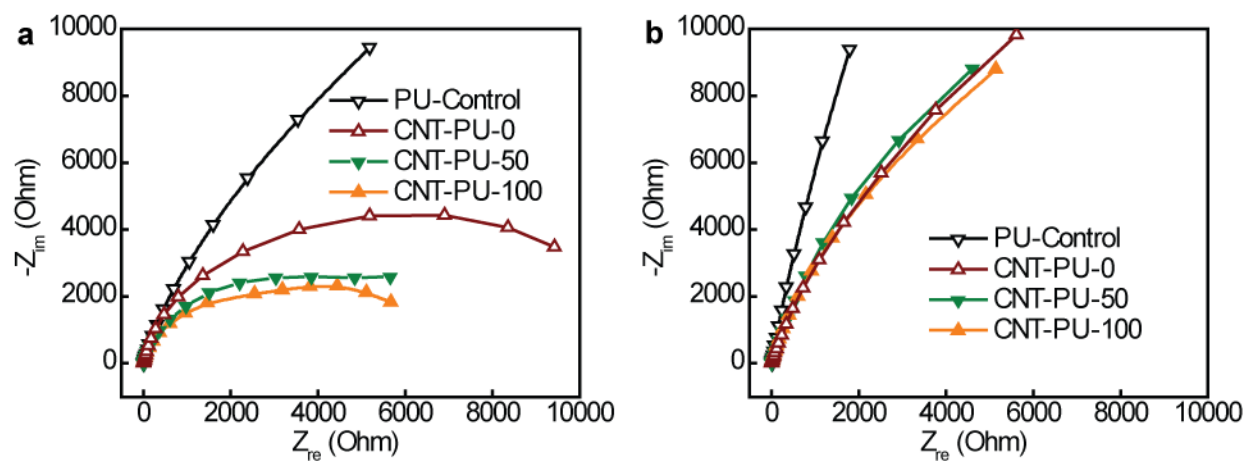


**Figure S4. Mesoscale crinkly CNT thin film on PU sponge.** (a) Schematic illustrating aligned wavy morphologies of CNT thin films. Clamps are applied to restrict the expansion of the PU sheet in only one direction. (b) and (c) SEM images of aligned wavy (b) and random crinkly (c) CNT thin film. (d) and (e) Color-coded orientation mappings of SEM images of aligned wavy (b) and random crinkly (c) CNT thin film, where different feature orientations show in different colors. (f) Angle distribution of SEM features in aligned wavy and random crinkly CNT thin film.

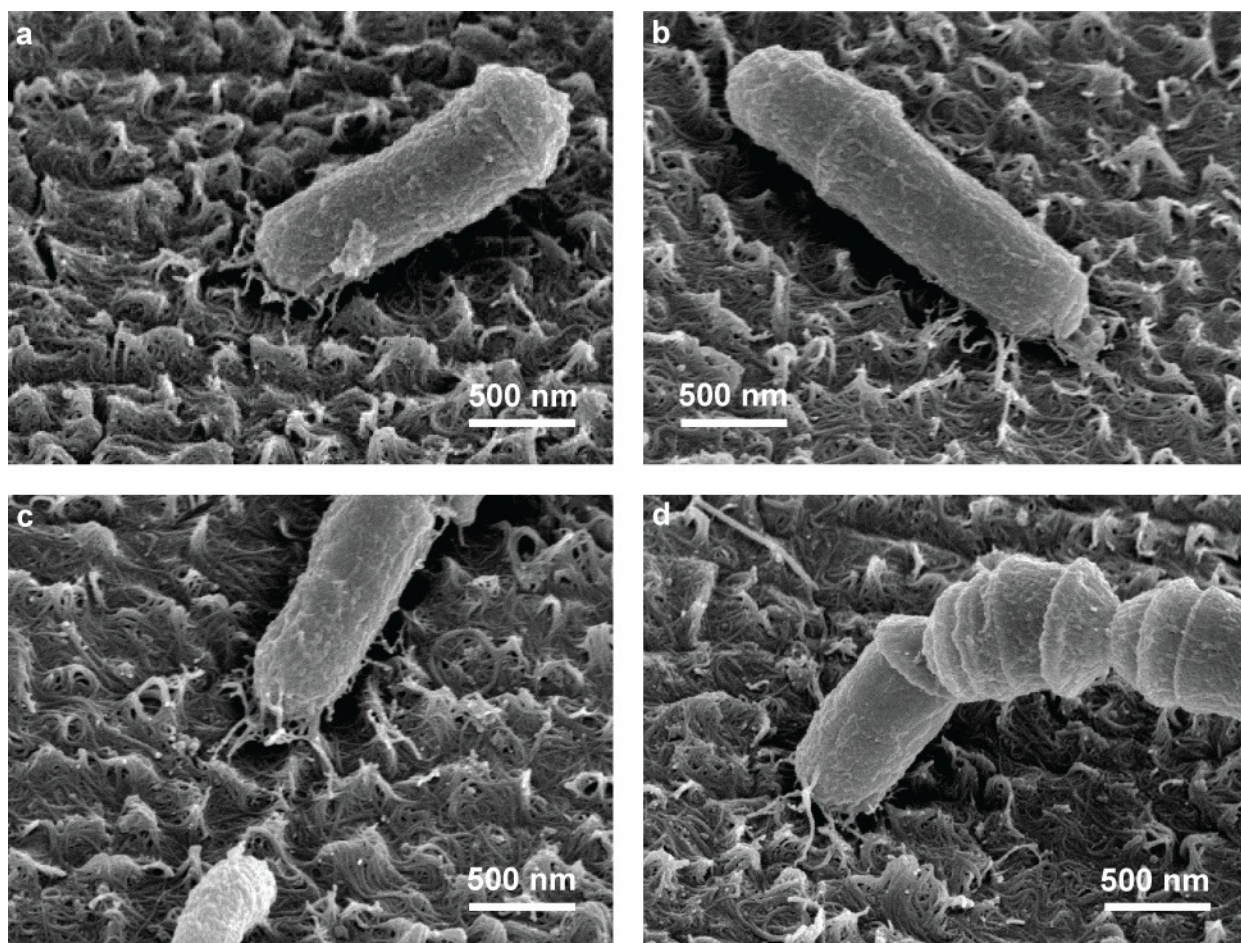


**Figure S5.** Hippocampal neurons after 24 h culture on different substrates, including PU only (a), CNT-PU-0 (b), CNT-PU-50 (c), and CNT-PU-100 (d).





**Figure S6. Nyquist curve of the electrochemical impedance spectroscopy test for the different anode samples with (a) and without (b) microorganisms.**



**Figure S7. SEM images of microorganisms on PU sheet with a crinkled CNT thin film.**