Supporting Information

Highly Electrically Conductive Biomass-Derived Carbon Fibers for Permanent Carbon Sequestration

Contents

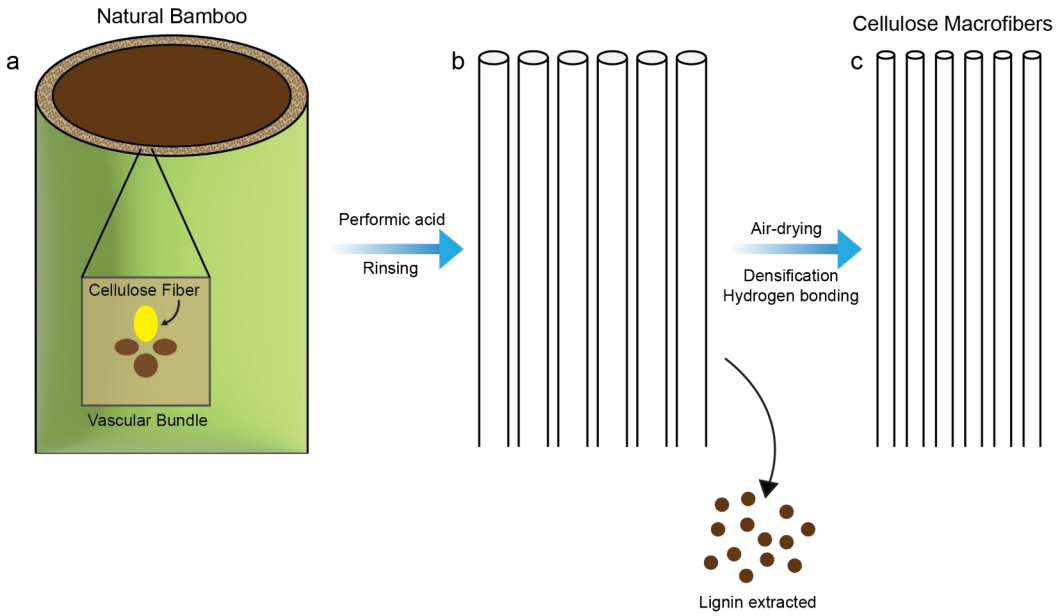

Figure S1. Schematic for producing cellulose fibers and lignin. (a) Natural bamboo is made up of vascular bundles containing cellulose macrofibers surrounded by a lignohemicellulosic matrix. (b) Macrofibers are extracted via performic acid treatment, sodium hydroxide neutralization, and rinsing to remove residual chemicals. (c) Macrofibers are air-dried for 24-48 hours resulting in densification and formation of strong hydrogen bonds.

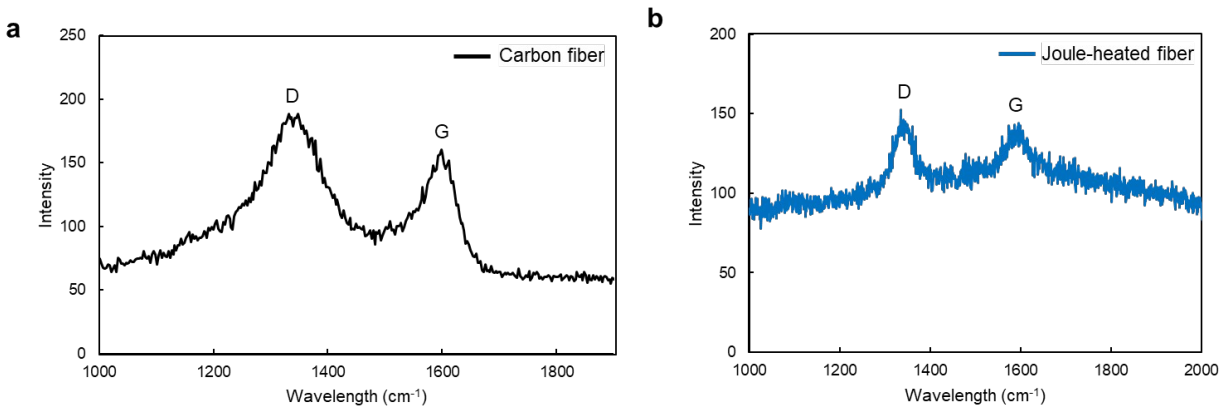

Figure S2. Raman spectroscopy of carbon fibers and Joule-heated fibers. (a) Raman spectra of carbon fiber. (b) Raman spectra of Joule-heated fiber with a slightly higher I_D/I_G ratio.

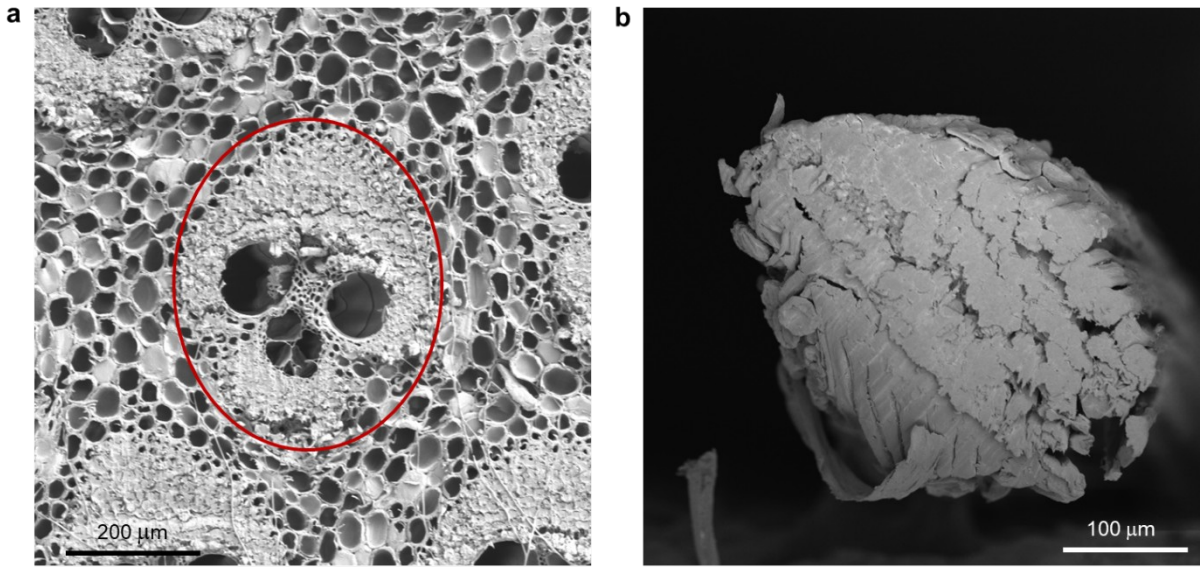

Figure S3. SEM images of natural bamboo and cellulose. (a) Natural bamboo is made up of vascular bundles containing cellulose macrofibers surrounded by a lignohemicellulosic matrix. (b) Extracted cellulose macrofiber showing macrofibrils and aligned microfibrils.

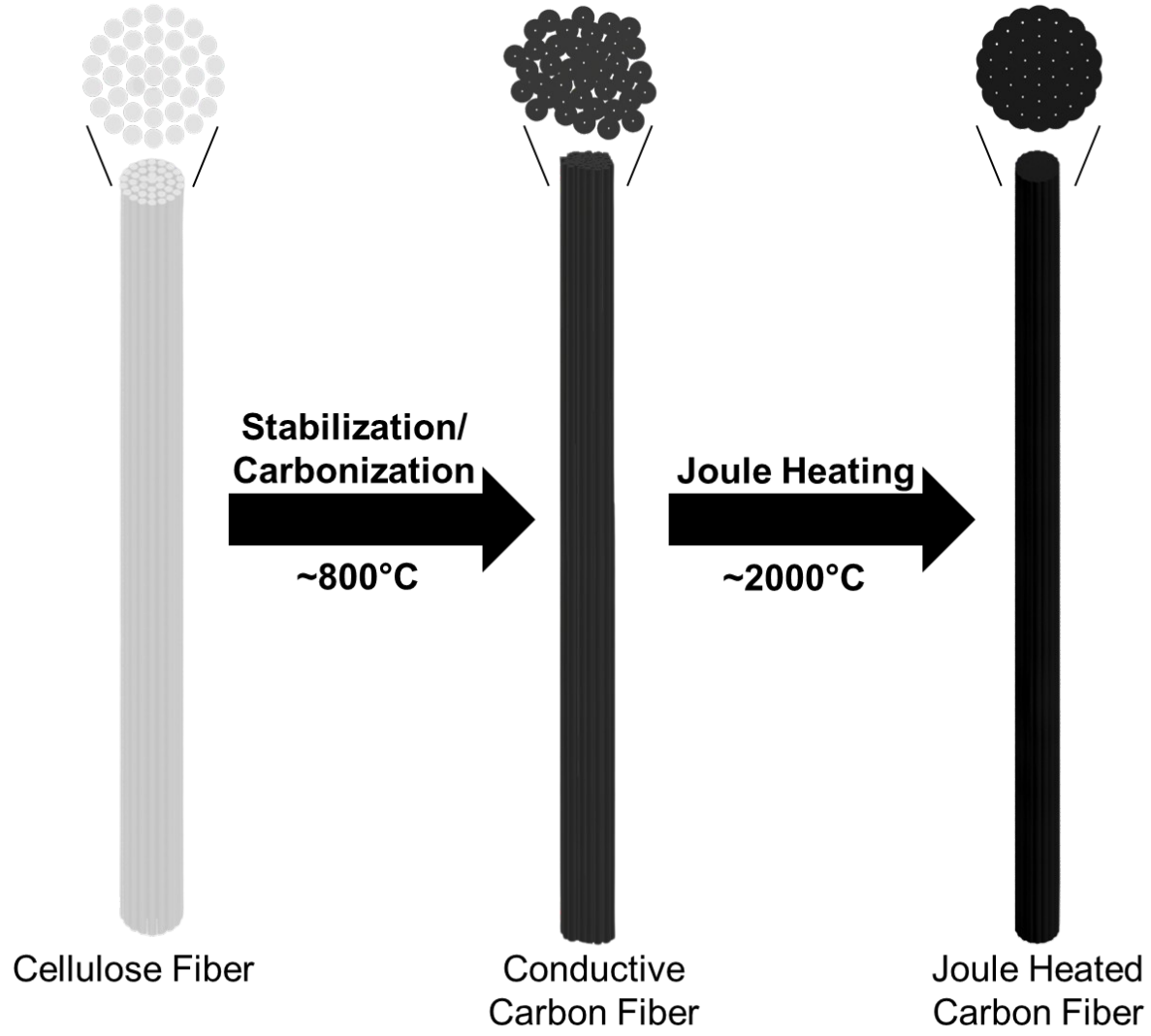

Figure S4. More detailed schematic of cross-sectional structural changes of fibers. (a) Natural bamboo cellulose macrofibers are made of hydrogen-bonded macrofibrils. (b) Most-non carbon atoms are removed and resulting carbon fiber is somewhat irregular. (c) High temperature Joule heating regularizes carbon fiber, leading to high electrical conductivity.

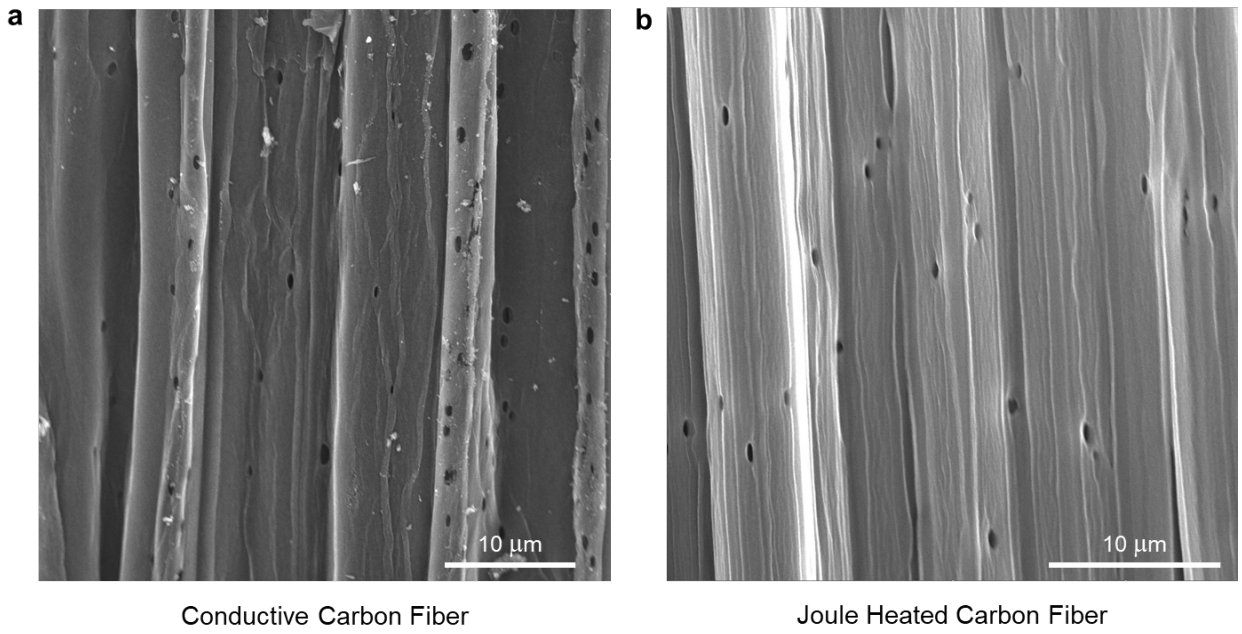

Figure S5. Increasing alignment of nanofibrils and formation of macropores. (a) Close-up view of a carbon fiber with somewhat aligned nanofibrils. (b) Close-up view of a Joule heated fiber with highly aligned nanofibrils.

Table S1. Carbonization Temperatures of Carbon Fibers. Temperatures at which carbon fibers in compared papers were carbonized at [20][21][22][23].

Precursor	Carbonization Temperature (°C)
Lignocellulose	900
Sugar Maple Lignin/PAN	1000
Lignin/Nanocellulose	1000
Ramie-derived	2000
Bamboo Cellulose Macrofibers (this work)	~2000