Supplementary Information

Facile and Eco-friendly Extraction of Cellulose Nanocrystals *via* Electron Beam Irradiation Followed by High-pressure Homogenization†

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†Electronic supplementary information (ESI) available. See DOI:

‡These authors contributed equally to this work.

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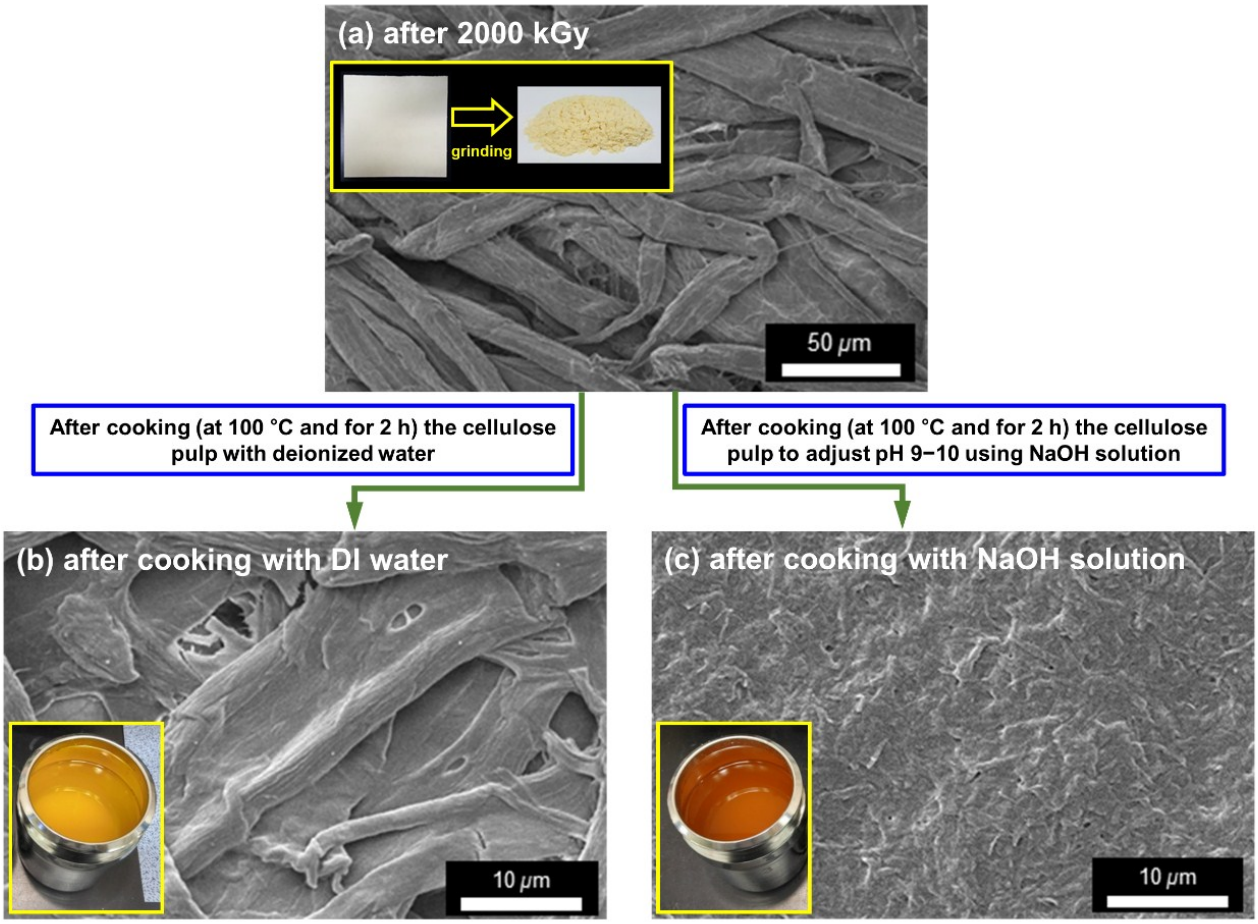

Fig. S1 SEM images of (a) cellulose pulp treated by EBI with 2000 kGy (inset: photos of used pulp sheet and cellulose pulp powder obtained after grinding), and (b and c) EBI-treated cellulose pulps after cooking with DI water or NaOH solution (adjusted to pH 9−10), respectively (insets: the filtrate solutions after water- or alkaline-treatment).

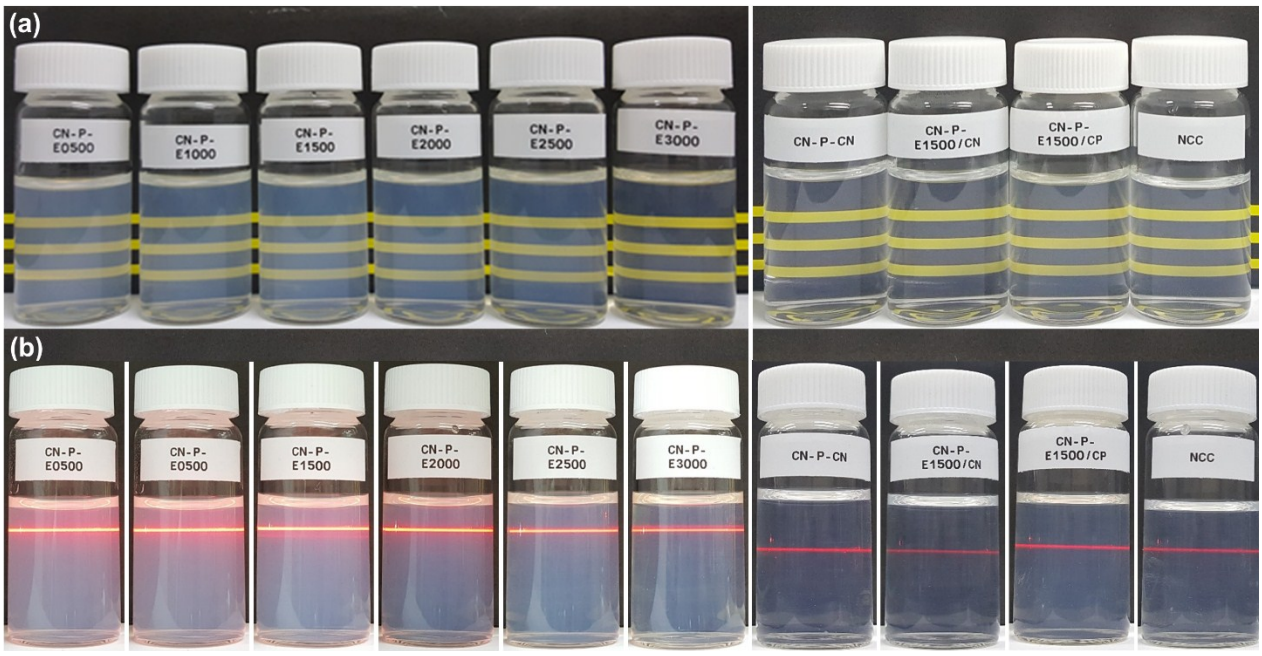

Fig. S2 (a) Images of aqueous suspensions (0.3% w/v) of the CNCs directly disintegrated by high pressure homogenization, which were taken after free settling for two months at room temperature. (b) Photos showing the Tyndall scattering effect (He–Ne laser, 632.8 nm), confirming the presence of nanoparticles.

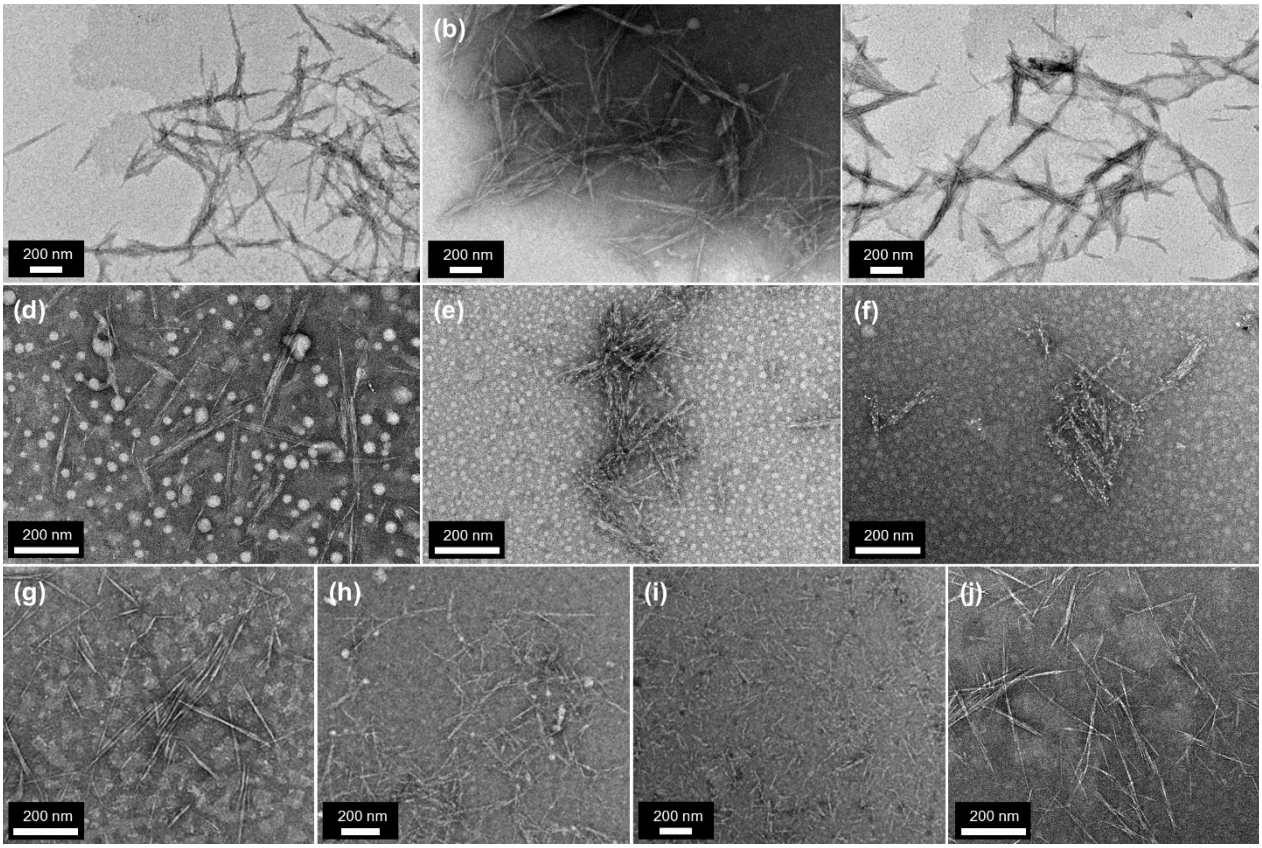

Fig. S3 TEM images of CNC samples extracted from cellulose pulps disassociated by electron-beam irradiation or/and chemicals, including an industrially produced CNC. (a) CN-P-E0500, (b) CN-P-E1000, (c) CN-P-E1500, (d) CN-P-E2000, (e) CN-P-E2500, (f) CN-P-E3000, (g) CN-P-CN, (h) CN-P-E1500/CN, (i) CN-P-E1500/CP, and (j) NCC^{TM} as the CNC produced by CelluForce.

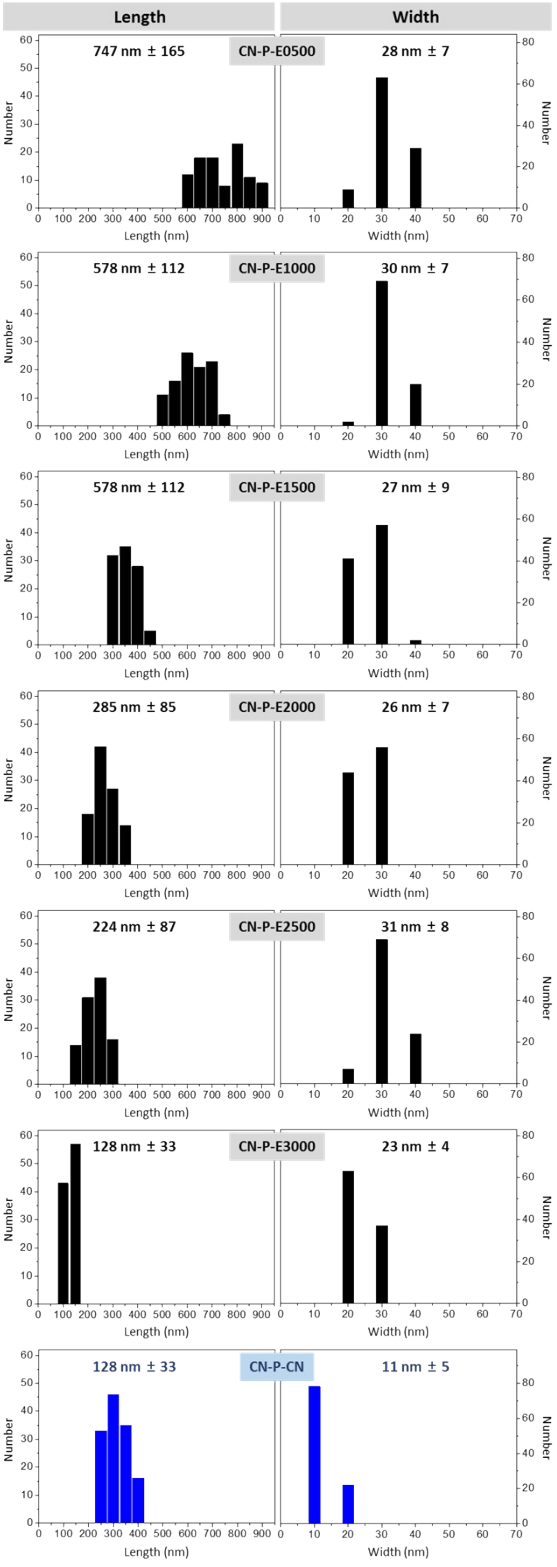

Fig. S4 Length (left column) and height (right column) distribution histograms and average values ± one standard deviation for EBI-induced and sulfuric acid-hydrolyzed CNCs (CN-P-E series and CN-P-CN).

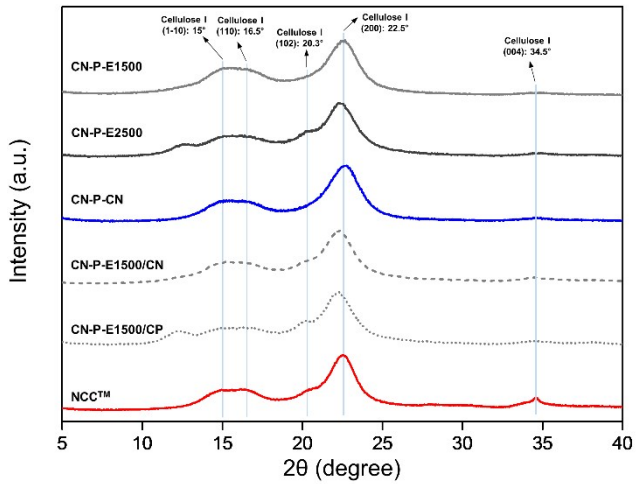

Fig. S5 X-ray diffraction of the CNC suspensions.

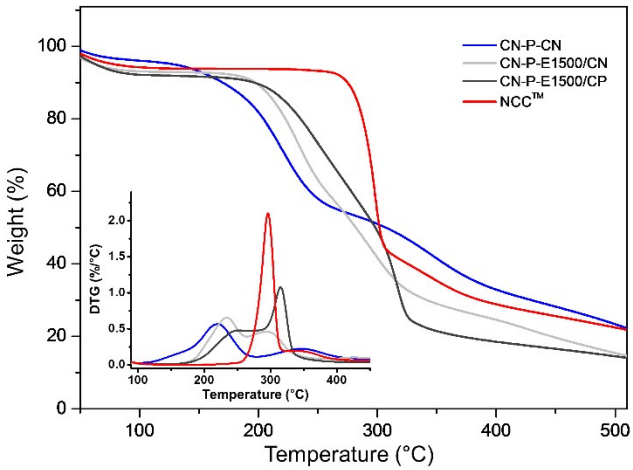

Fig. S6 TGA thermograms of the further oxidized/cationized CNCs, including CN-P-CN prepared through sulfuric acid hydrolysis and NCC™. The insets show the DTG curves.

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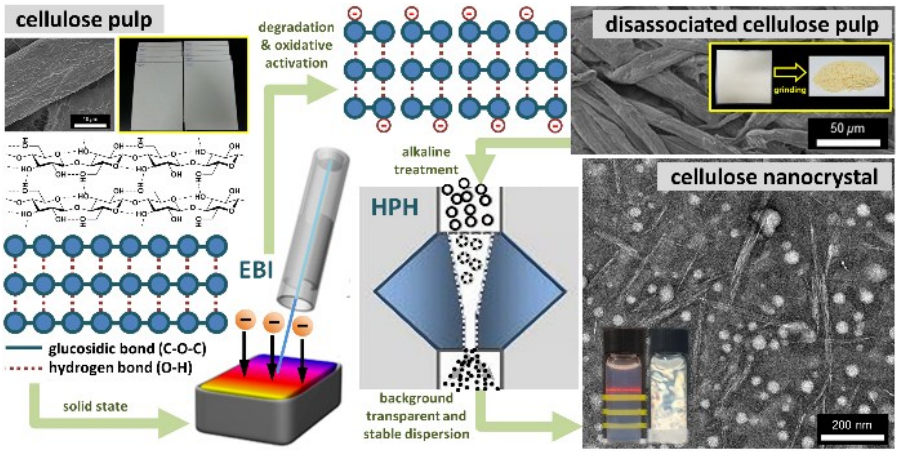

Cellulose nanocrystals were prepared *via* short-time pretreatment by electron-beam irradiation in the solid state and disintegration using high pressure homogenization.