

Effect of bleaching process on the allomorph, crystalline index, morphology, and thermal stability of cellulose nanocrystals derived from rice straw

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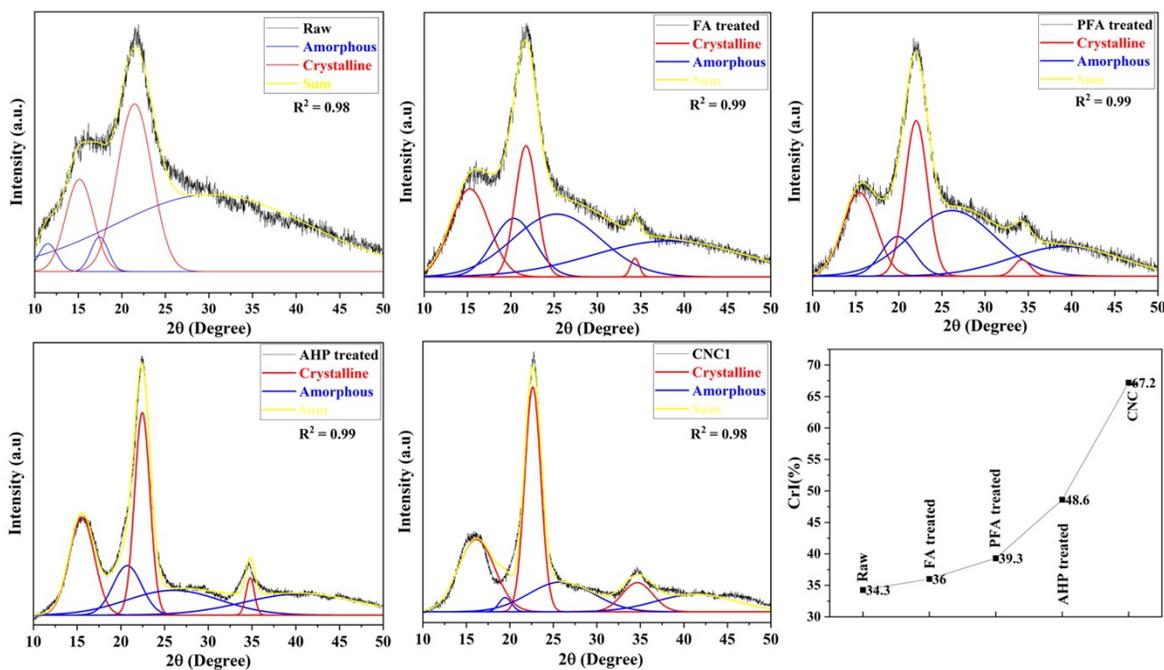
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Supporting information



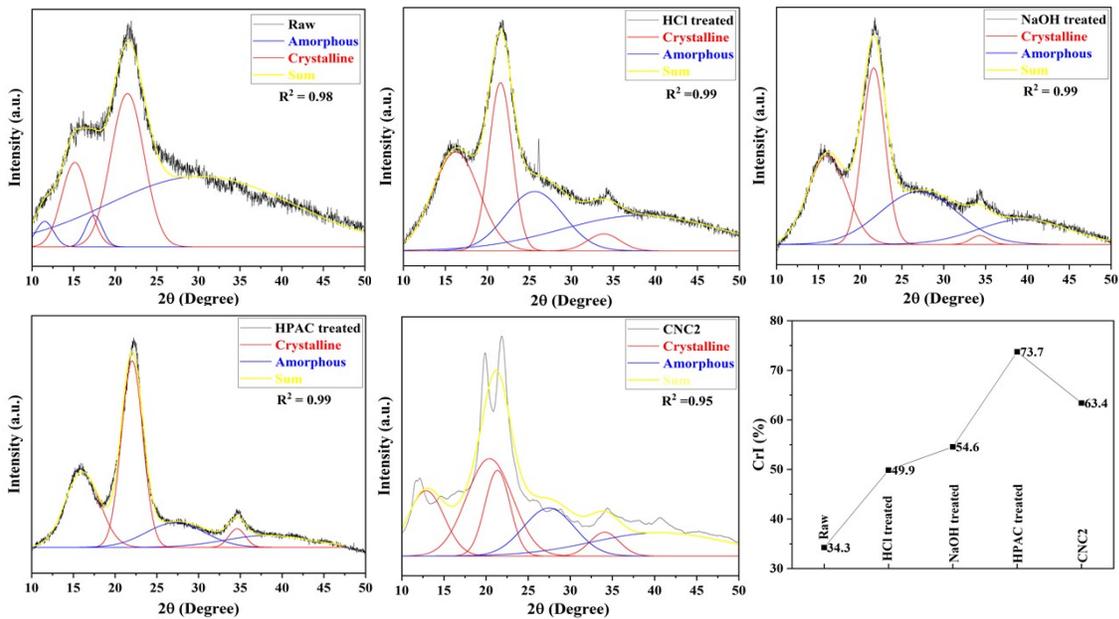
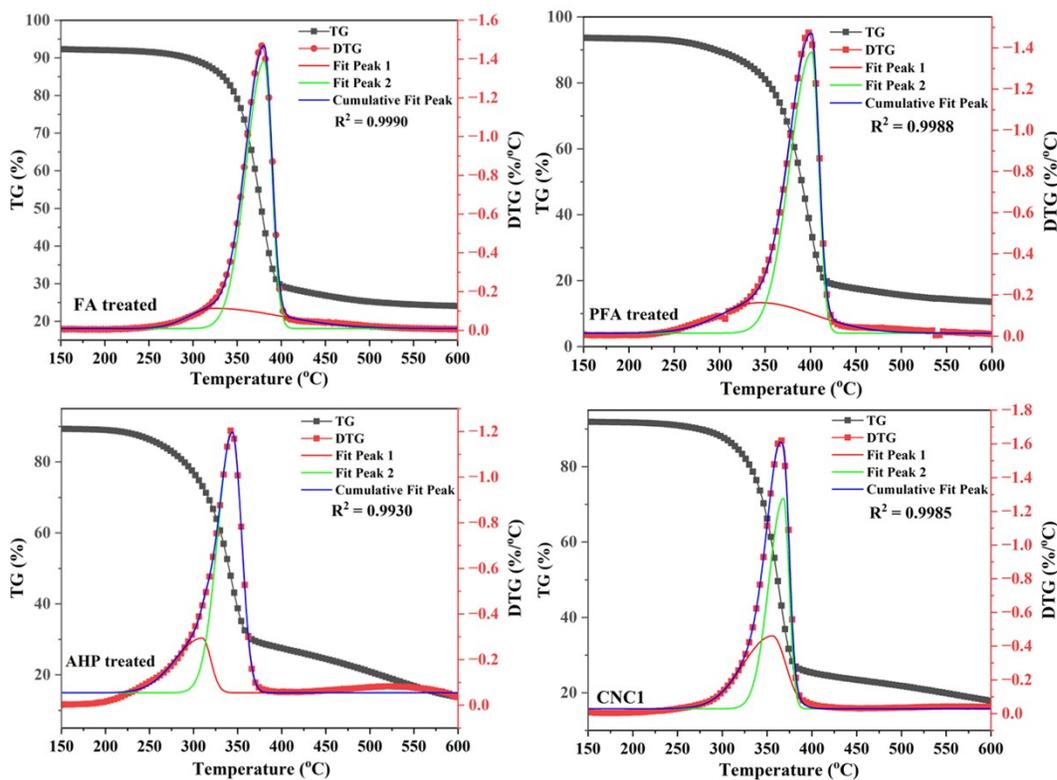


Fig. S1. Each XRD peak of treated RS samples is deconvoluted by crystalline and amorphous peaks and the CrI chart.



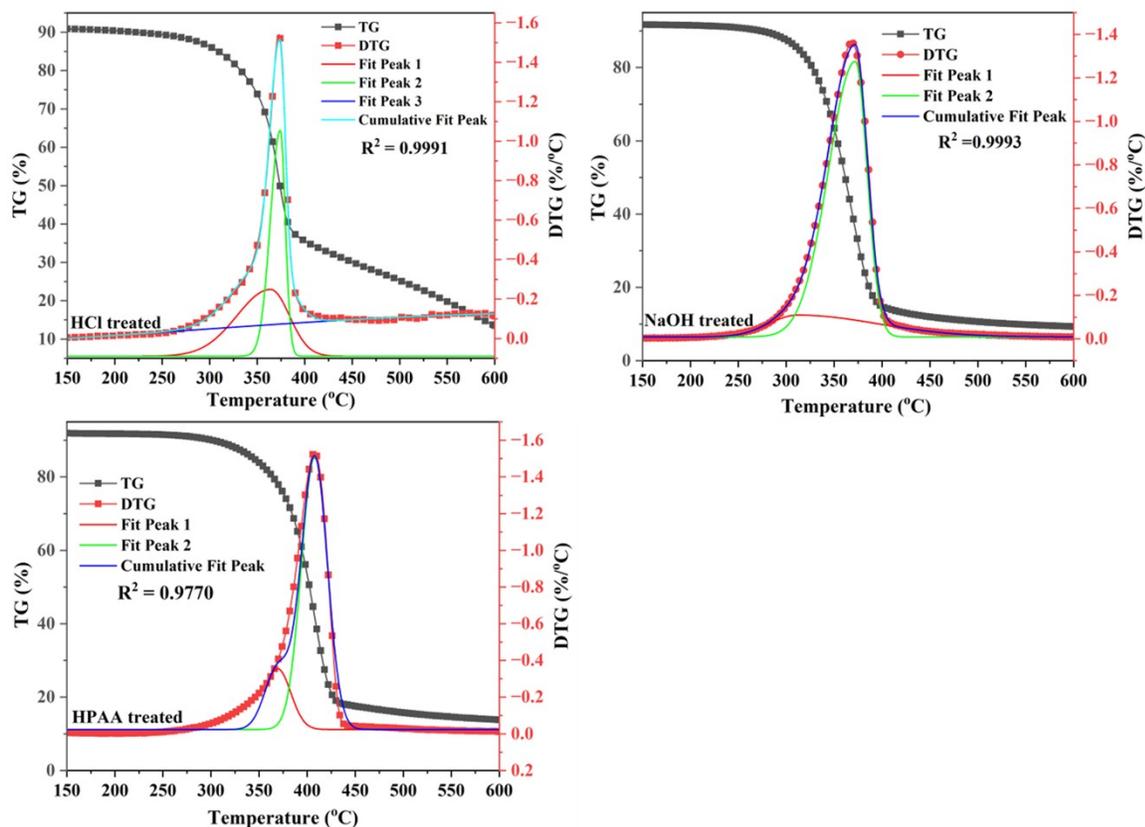


Fig. S2. TGA and DTG's devolatilization stage deconvolution of treated RS samples

Table S1. The assignment of the most important Raman bands for cellulose I and II from the spectral region 200 to 1600 cm^{-1}

ν = stretching, δ = in plane scissoring, ρ = in plane rocking, τ = out of plane twisting

Relative band intensities in a spectrum are indicated by s: strong, m: medium, w: weak, sh: shoulder

AHP treated	CNC1	Assignments[1-4]
252 (sh)		τ (COH)
308+(m)		τ (COH)
330*sh	332*s	Heavy atom bending; ring twisting
380s	380m	some heavy atom stretching; τ (CCC) ring
470s	470m	-
489m	489m	-
520*sh		some heavy atom stretching; ν (CCO) ring glycosidic
542w	542s	
	595*w	δ (CCH) twisting

610*sh		$\delta(\text{CCH})$ twisting
725* m		-
896+s		$\nu(\text{COC})$ in plane symmetric
	971* w	heavy atom (CC and CO); $\rho(\text{CH}_2)$
997*w		Stretching, C–C and C–O; $\rho(\text{CH}_2)$
1036w	1036w	Stretching, C–C and C–O; $\nu(\text{CO})$ primary OH
1056w		Stretching, C–C and C–O; $\nu(\text{CO})$ secondary OH
1092s		Amorphous cellulose
1121m		Stretching, C–C and C–O; $\nu(\text{COC})$ in plane sym
1152*w		heavy atom stretching plus, HCC and HCO bending; $\nu(\text{CC})$ ring breathing asym
1265+m		HCC and HCO bending; $\delta(\text{CH}_2)$; $\delta(\text{CH}_2)$ twisting
1339*s		HCC, HCO, and HOC bending; $\delta(\text{CH}_2)$
1374+s		HCC, HCO, and HOC bending; $\delta(\text{CH}_2)$
1413+m		HCC, HCO, and HOC bending; $\delta(\text{CH}_2)$
1476*w		HCH and HOC bending; $\delta(\text{CH}_2)$ scissors

HPAA treated	CNC2	Assignments[1-3]
	220 (s)	-
	260 (s)	-
	308+(s)	$\delta(\text{CCO})$
330*m		Heavy atom bending; ring twisting
346*m		some heavy atom stretching
	356 (m)	Amorphous cellulose
376+	376+	some heavy atom stretching; $\delta(\text{CCC})$ ring
406*w		-
	419+	-
	436 (m)	Amorphous cellulose
437*		some heavy atom stretching; $\nu(\text{CCO})$ ring
458*m	458*(m)	some heavy atom stretching; $\nu(\text{CCO})$ ring
492m	492 (m)	some heavy atom stretching; $\nu(\text{CCO})$ glycosidic
522+m	522+(m)	some heavy atom stretching; $\nu(\text{CCO})$ ring glycosidic
566*s	566*(s)	some heavy atom stretching
	577+(w)	some heavy atom stretching
	896+ (m)	$\nu(\text{COC})$ in plane symmetric
898*(m)		$\nu(\text{COC})$ in plane symmetric
965+(w)		heavy atom (CC and CO); $\rho(\text{CH}_2)$
	969+(w)	heavy atom (CC and CO); $\rho(\text{CH}_2)$
997*w		Stretching, C–C and C–O; $\rho(\text{CH}_2)$
	1000+m	Stretching, C–C and C–O; $\rho(\text{CH}_2)$
	1028+m	Stretching, C–C and C–O; $\nu(\text{CO})$
1037*w		Stretching, C–C and C–O; $\nu(\text{CO})$ primary OH

1092	1092	Amorphous cellulose
1121*s	1121*s	Stretching, C–C and C–O; $\nu(\text{COC})$ in plane sym
1146+m	1146+m	heavy atom stretching plus, HCC and HCO bending; $\nu(\text{CC})$ ring breathing asym
1201*w	1201*m	$\delta(\text{COH})$; $\delta(\text{CCH})$
	1237+	$\delta(\text{COH})$ out of plane
	1338+	HCC, HCO, and HOC bending; $\delta(\text{CH}_2)$
1377s	1377s	Amorphous cellulose
	1463	Amorphous cellulose
1476*(w)		HCH and HOC bending; (CH_2) scissors

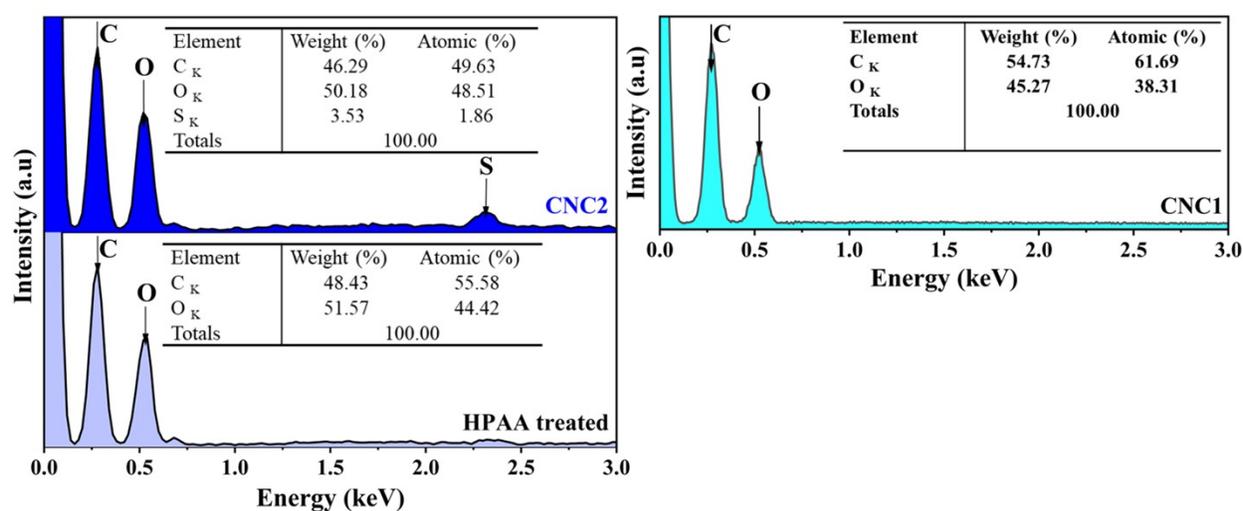


Fig. S3. EDX spectrum of HPAA-treated RS, CNC1 and CNC2

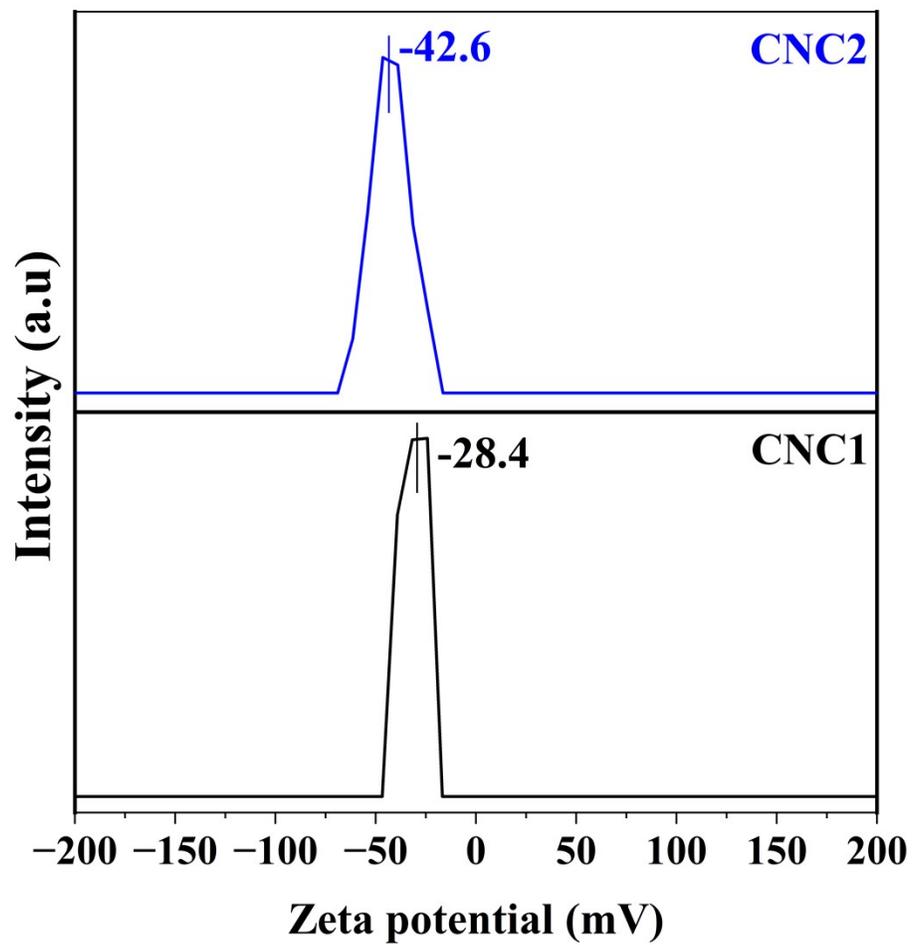


Fig. S4. Zeta potential of CNC1 and CNC2 suspension

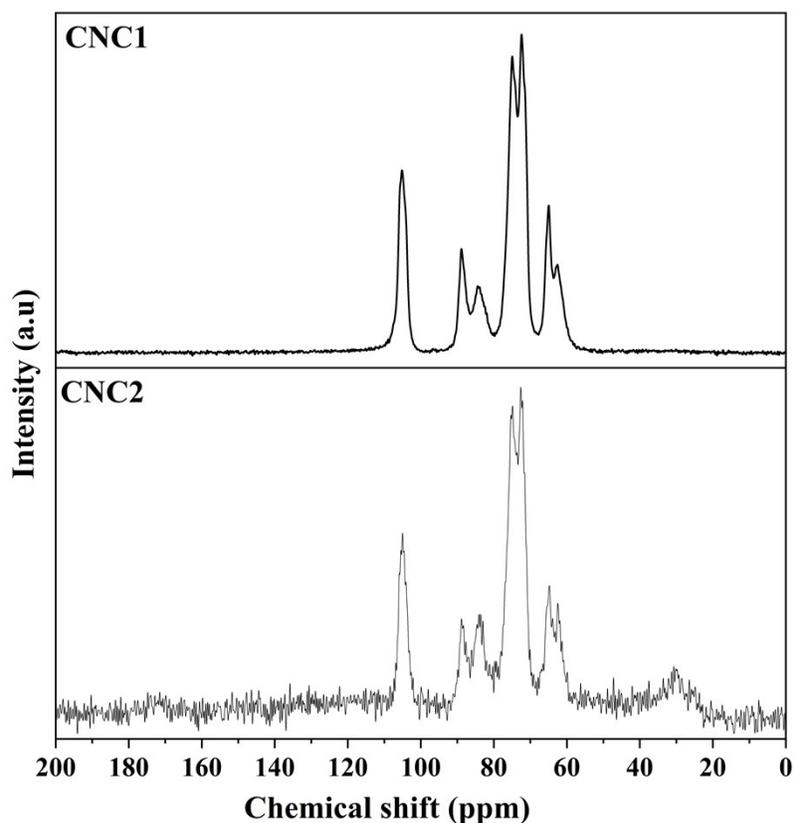


Fig. S5. ^{13}C NMR spectra of CNC1 and CNC2

References

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