Electronic Supplementary Material (ESI) for Green Chemistry.

Electronic Supporting Information

Neodymium recovery from e-waste:

A sustainable, instantaneous, and cost-effective method

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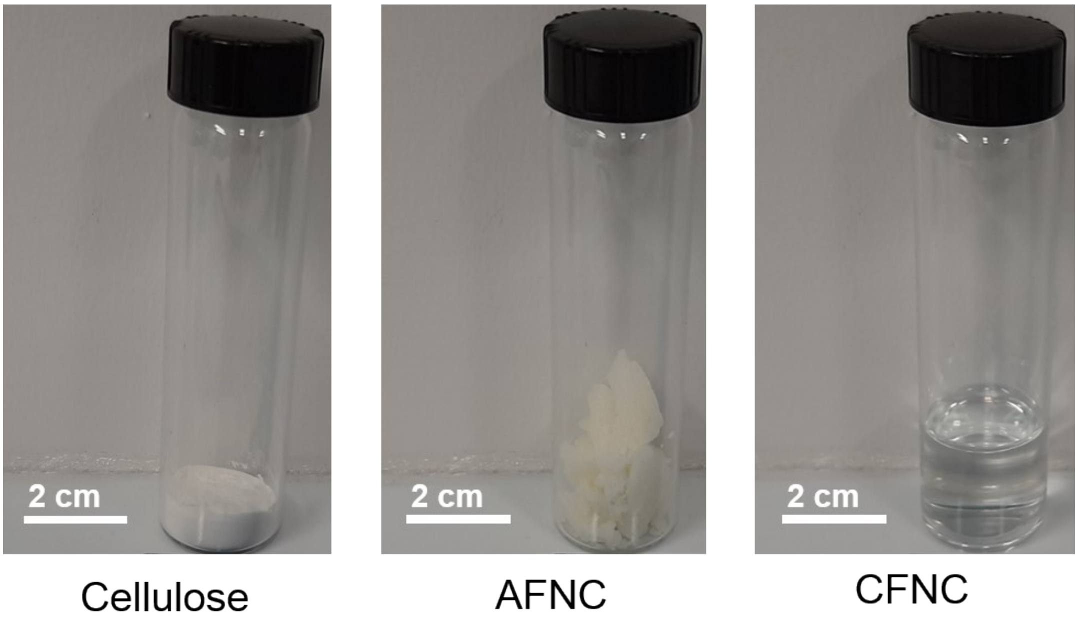

Figure S1. Image of the starting material (cellulose powder), synthesized aldehyde functionalized nanocellulose (AFNC), and carboxylate functionalized nanocellulose (CFNC).

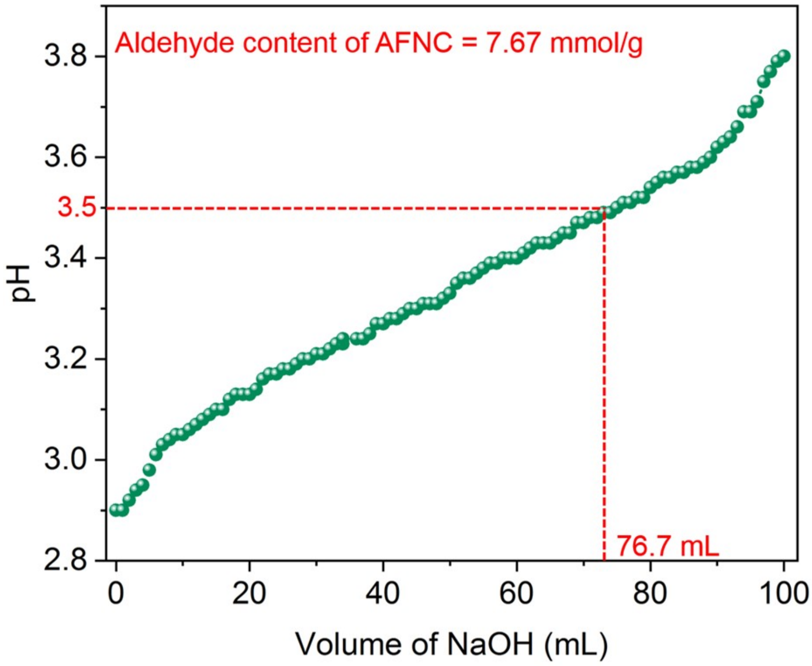

Figure S2. Aldehyde content measurement of AFNC by hydroxylamine hydrochloride titration.

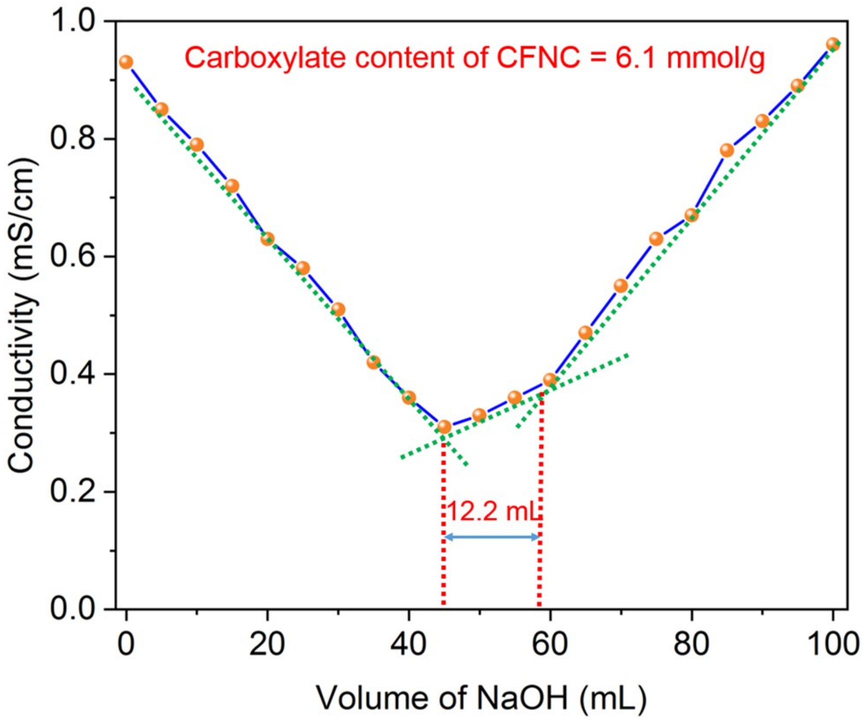

Figure S3. Conductometric titration curve of CFNC to measure the carboxylate content.

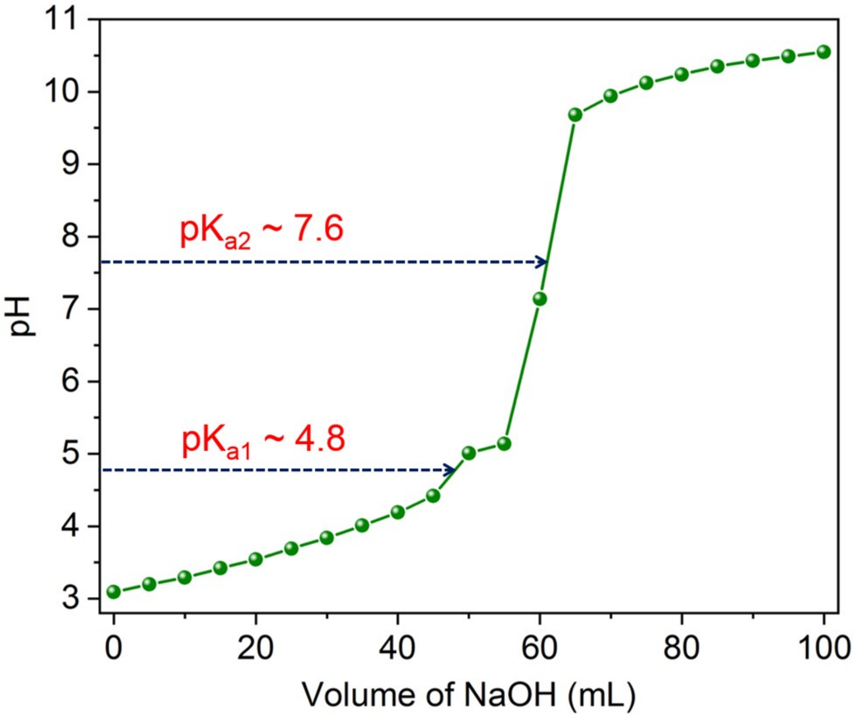

Figure S4. pH titration curve of CFNC obtained simultaneously with conductometric titration.

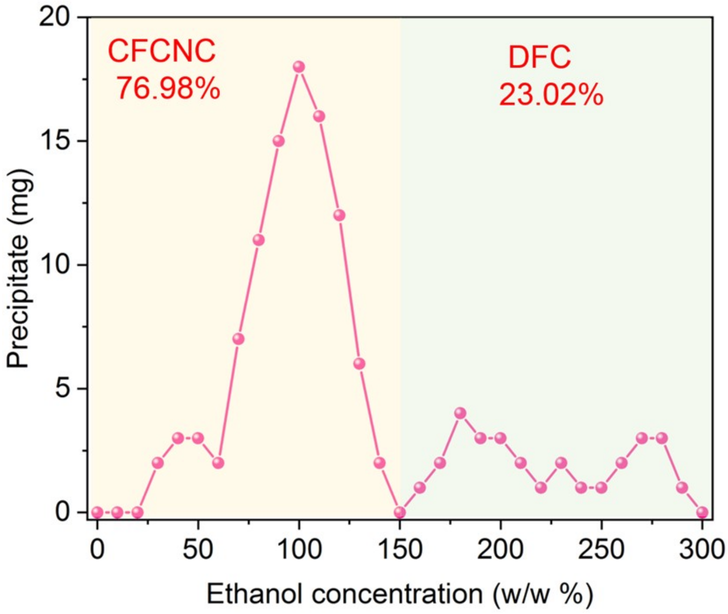

Figure S5. Ethanol mediated precipitation of CFCNC and DFC.

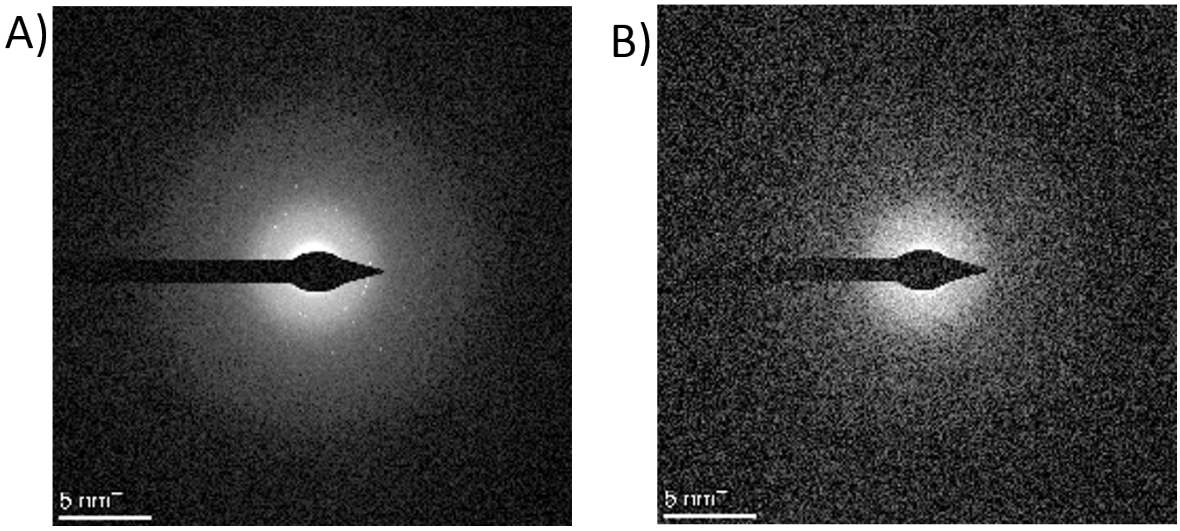

Figure S6. Selected area electron diffraction (SAED) of **A**) CFCNC showing crystalline features **B**) DFC displaying the amorphous nature.

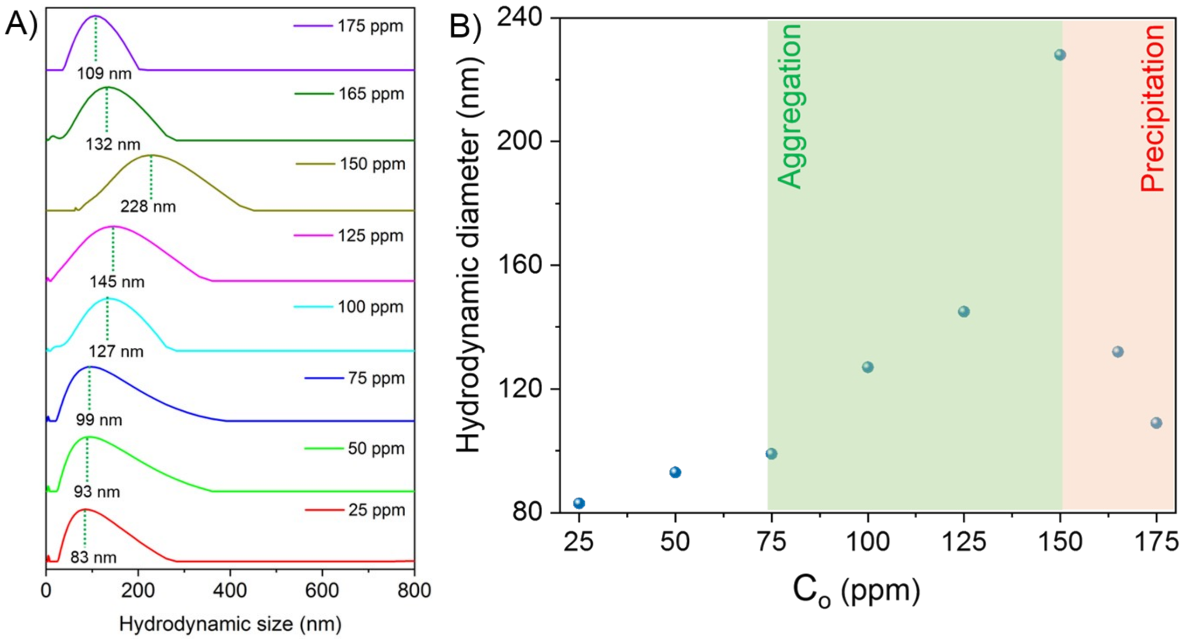

Figure S7. A) DLS measurement showing hydrodynamic size of the supernatant at different Nd^{3+} concentration. **B**) Plot of hydrodynamic size of Nd-CFNC aggregates in the supernatant against initial concentration (C_o) of Nd^{3+}.

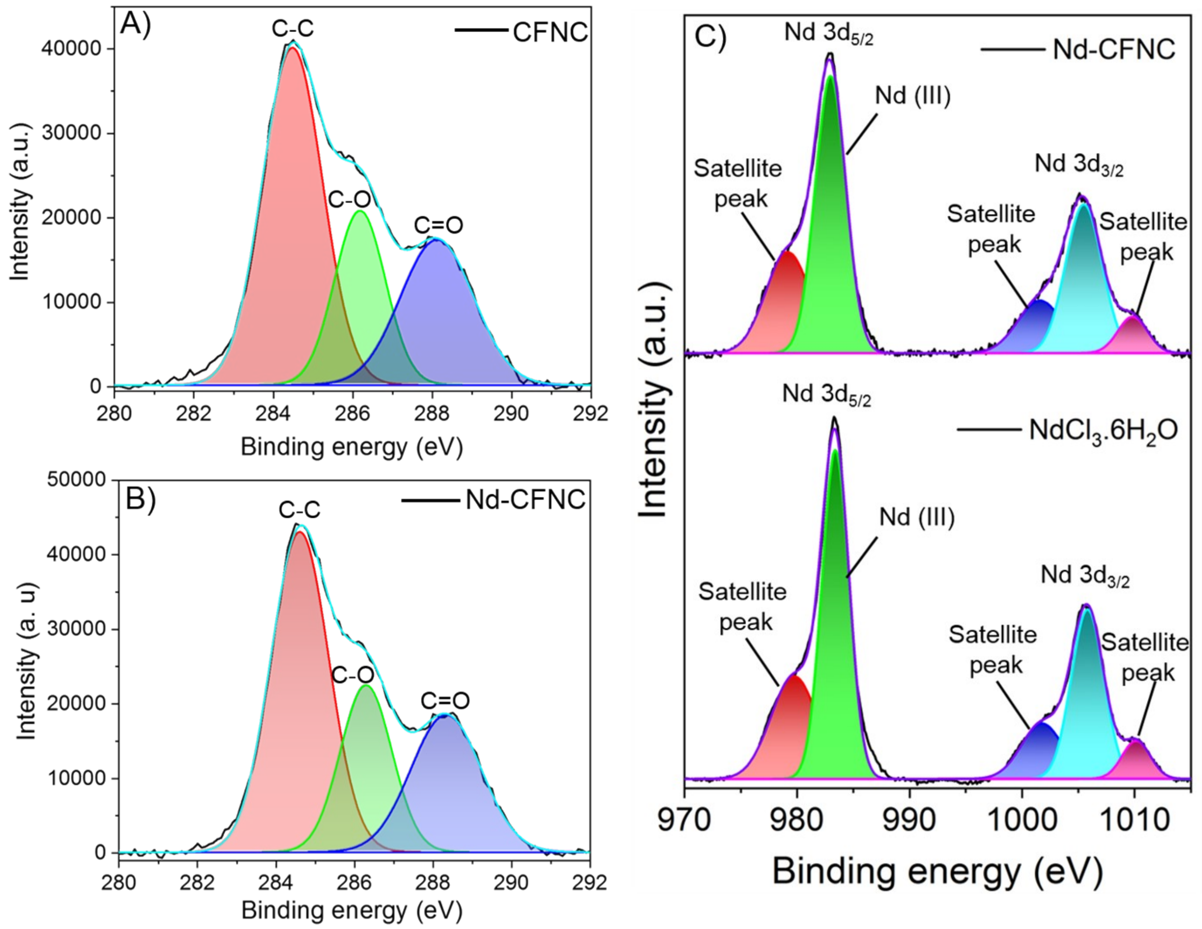

Figure S8. A) C 1s spectrum of CFNC. **B**) C 1s spectrum of Nd-CFNC. **C**) Nd 3d spectra of $NdCl_3.6H_2O$ salt and Nd-CFNC precipitate.

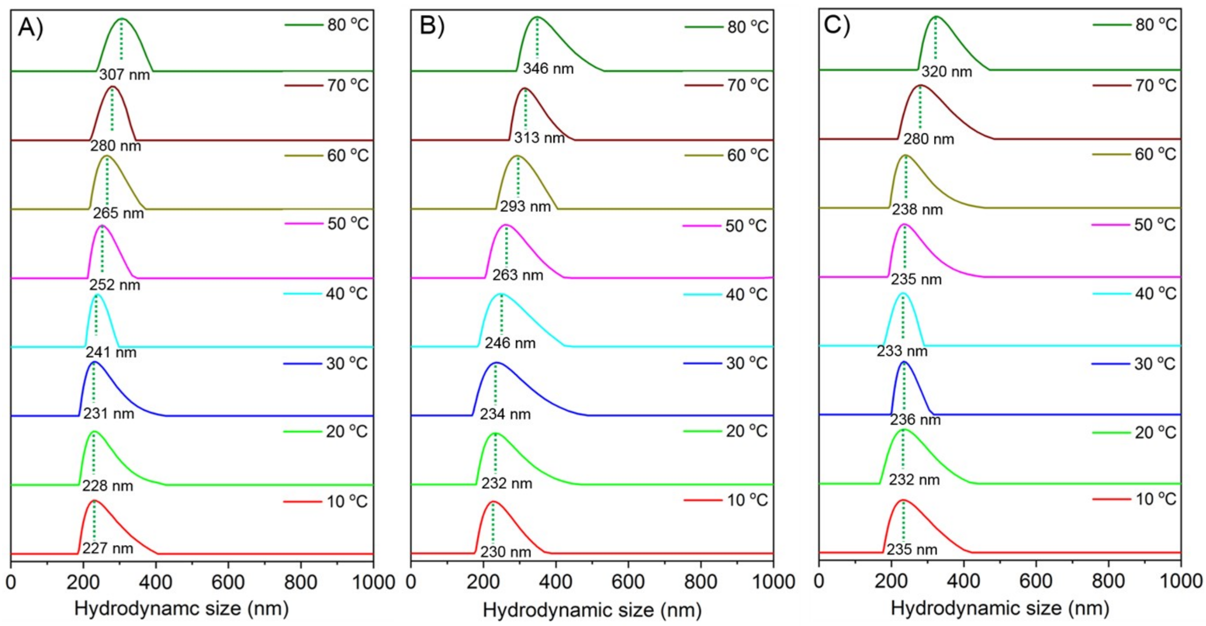

Figure S9. Change in the hydrodynamic size of CFNC in the supernatant **A)** When heated Nd^{3+} solution was added to CFNC at various temperatures. **B)** When Nd^{3+} solution was added to the heated CFNC at different temperatures. **C)** When already formed Nd-CFNC complex was heated at various temperatures.

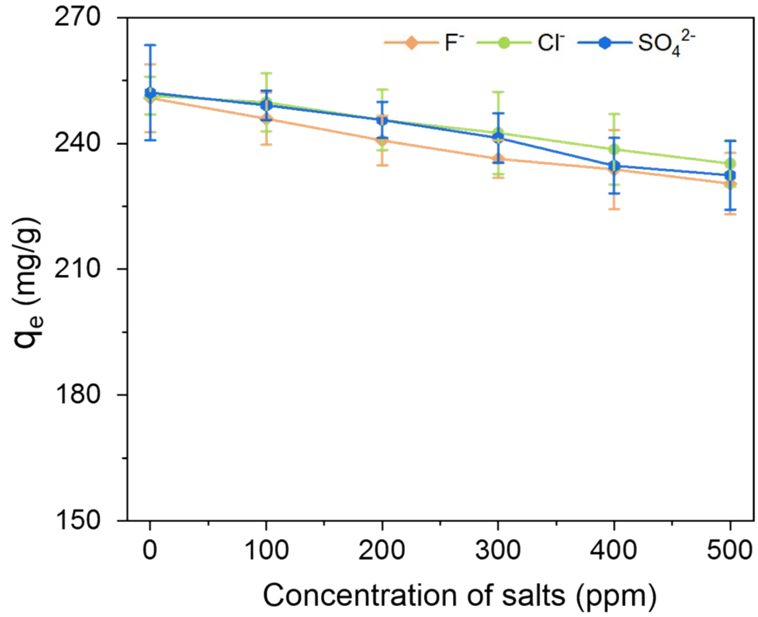

Figure S10. Nd^{3+} removal capacity of CFNC in presence of monovalent (F^-, Cl^-), and divalent anions (SO_4^{2-}).

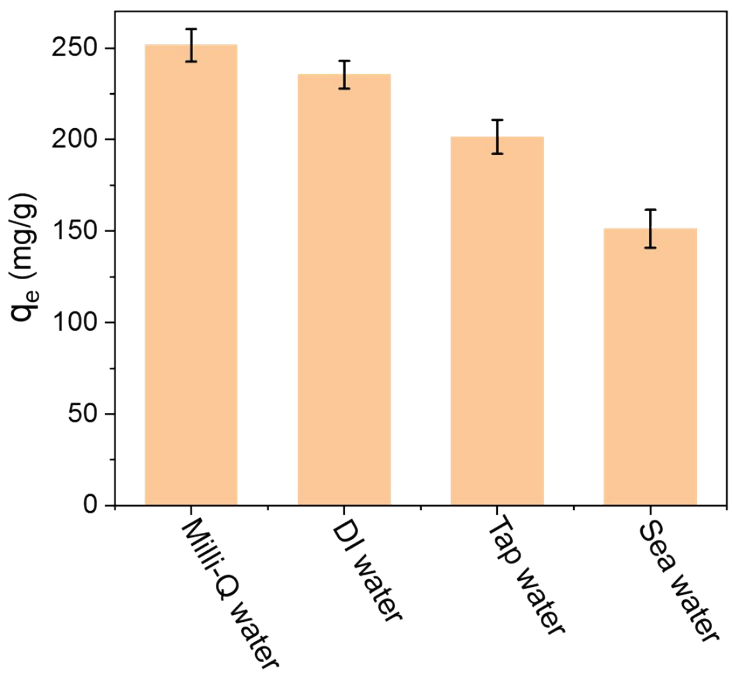

Figure S11. Comparison of Nd^{3+} removal capacity of CFNC in milli-Q water, DI water, tap water and sea water.

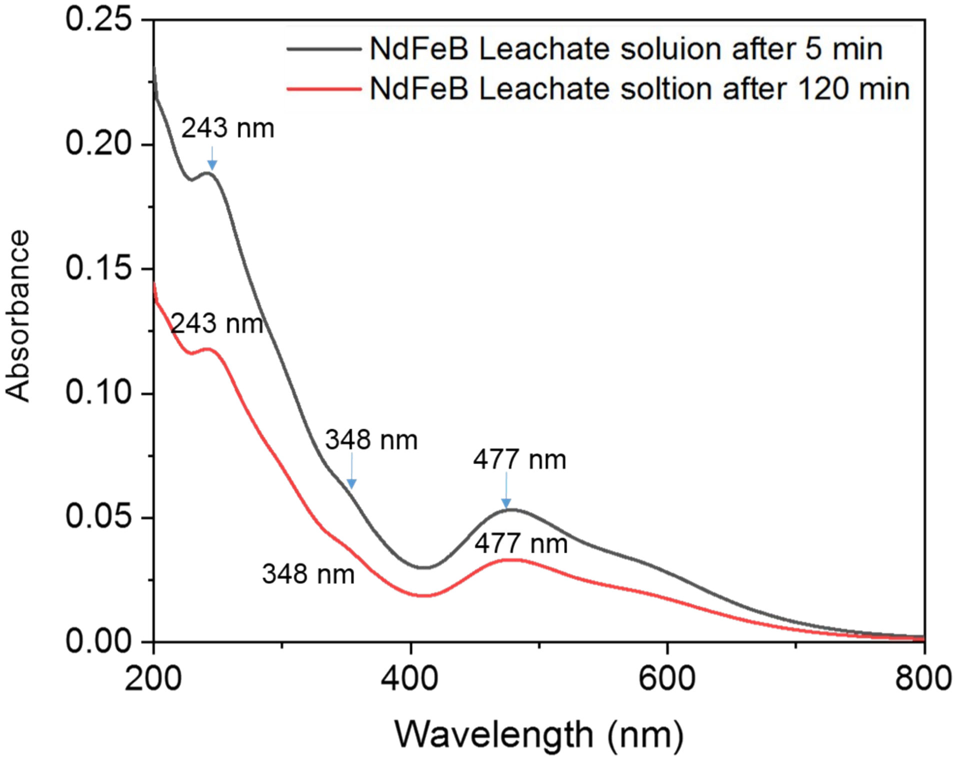

Figure S12. UV-Vis spectra of NdFeB leachate after 5 min and 120 min digestion with acid.

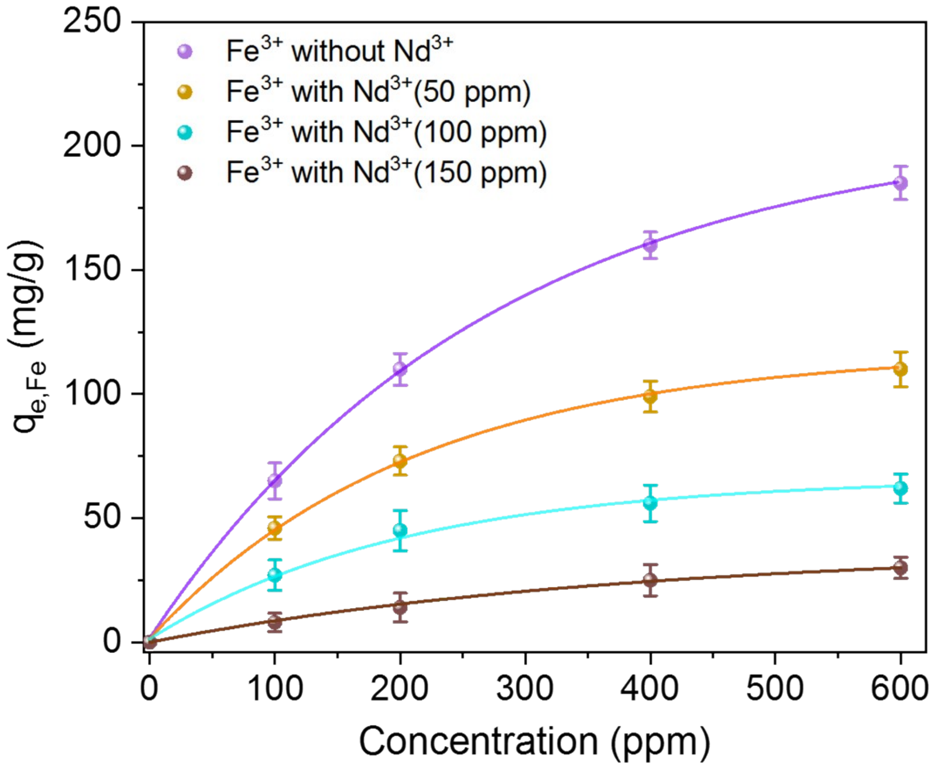

Figure S13. Fe^{3+} removal capacity in the absence and presence of various concentration of Nd^{3+}.

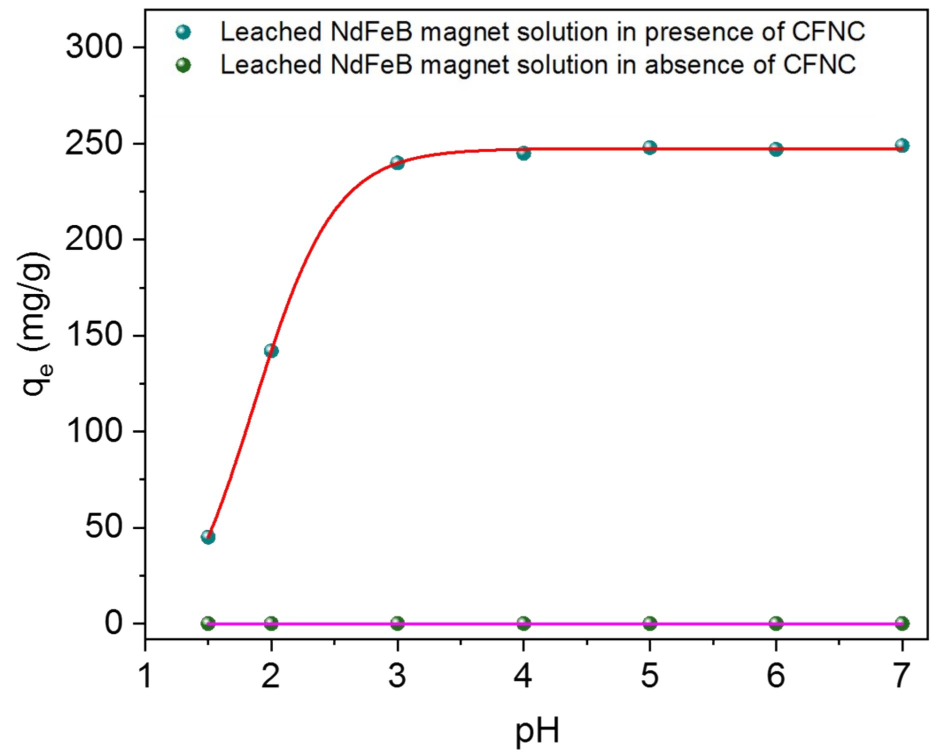

Figure S14. Nd^{3+} removal capacity from the leached NdFeB magnet solution in the presence and absence of CFNC at different pH.

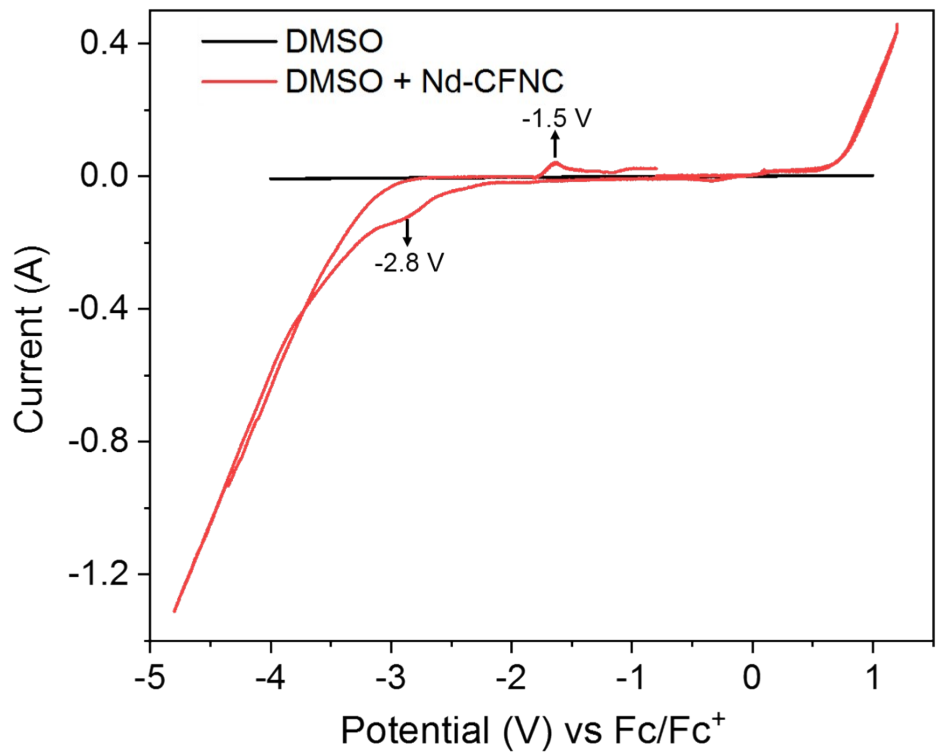

Figure S15. Cyclic voltammogram of DMSO and Nd-CFNC in DMSO.

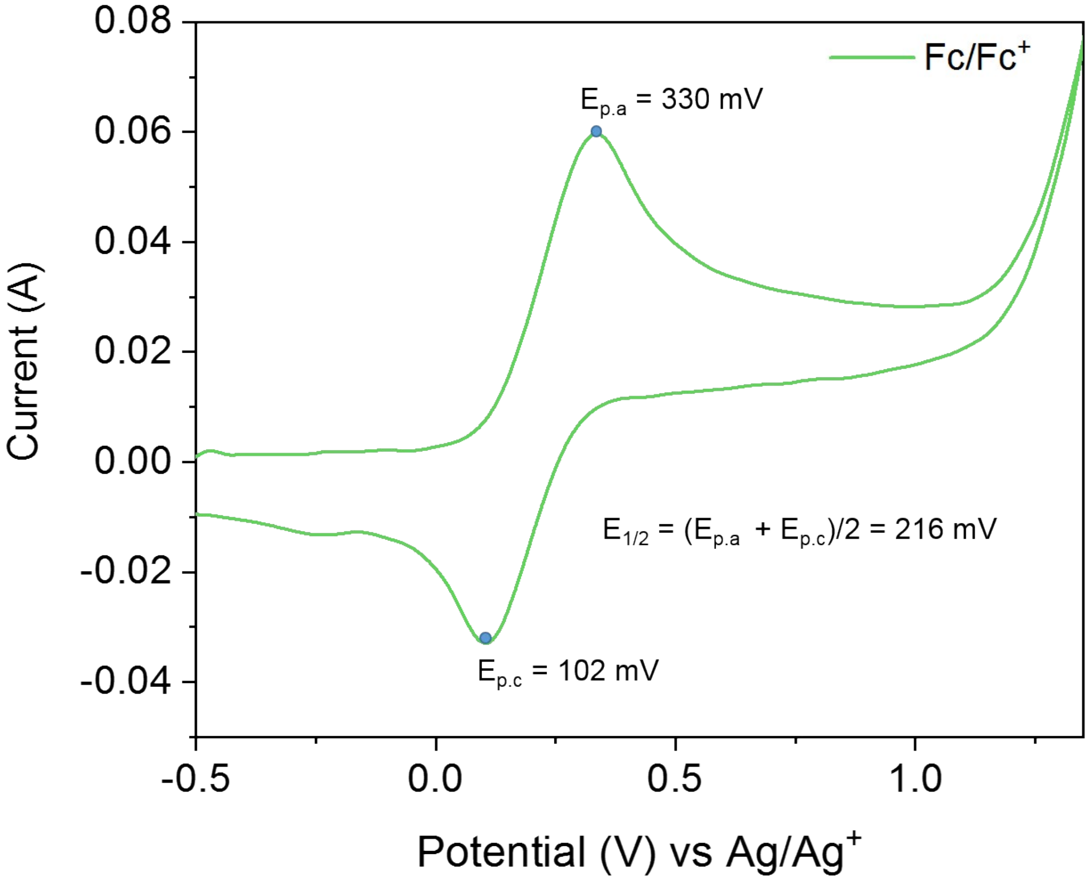

Figure S16. Cyclic voltammogram of Fc/Fc^+ vs Ag/Ag^+.

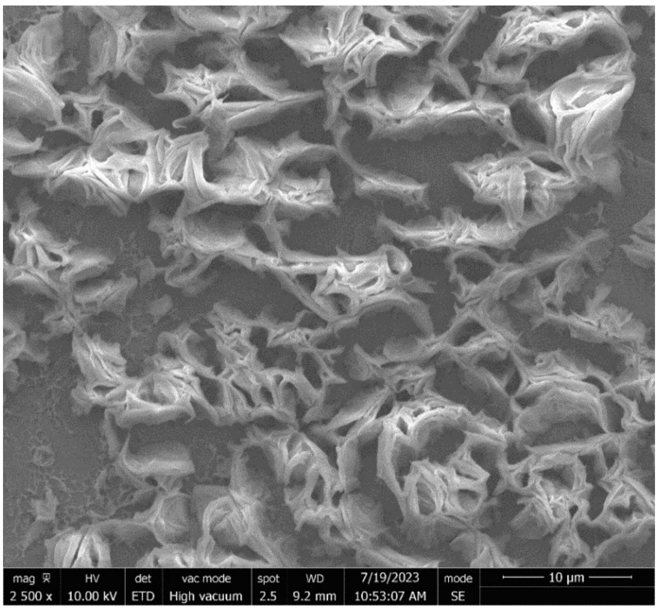

Figure S17. SEM image of the electrodeposited material (Nd/Nd_2O_3) that shows irregular morphology and porous nature.

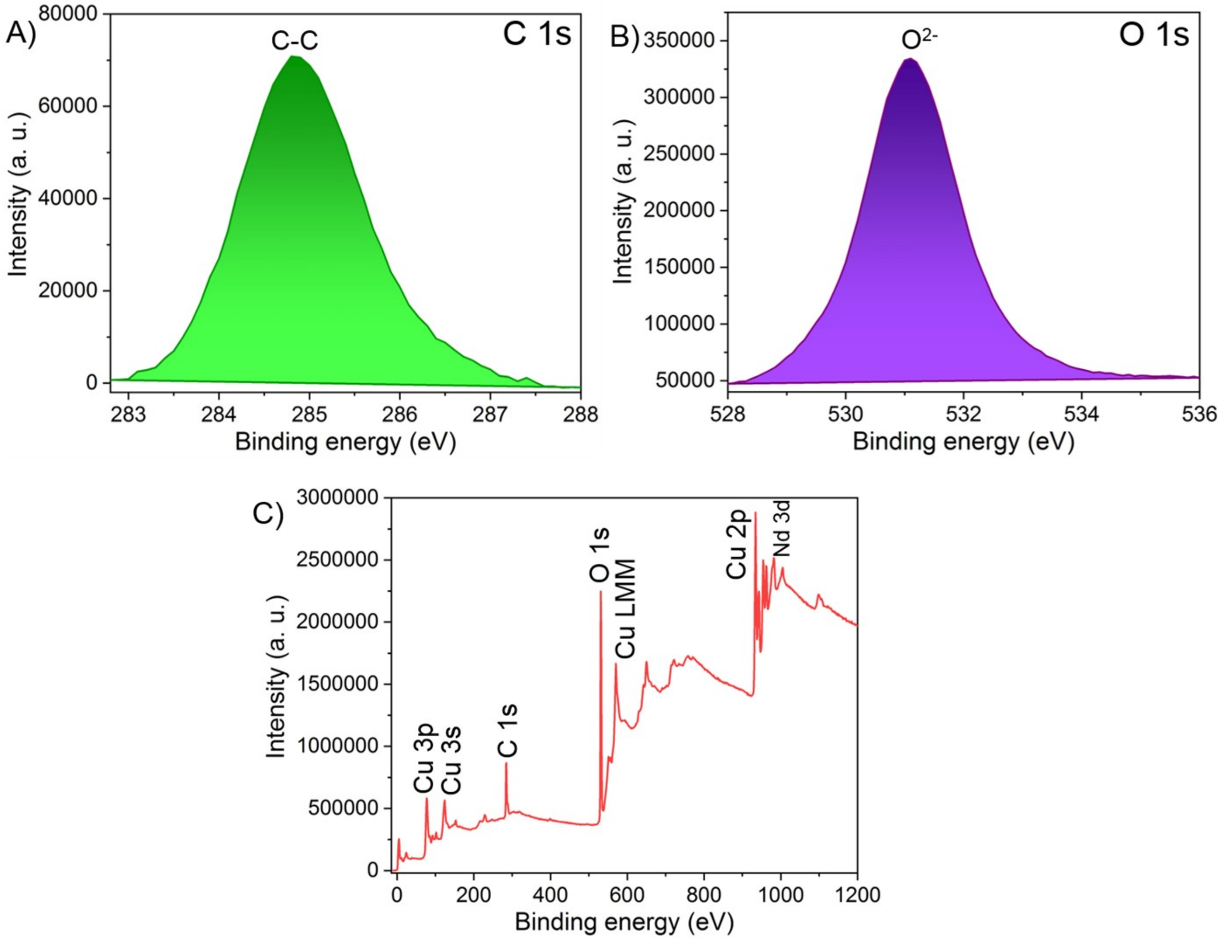

Figure S18. A) C 1s spectrum of electrodeposited Nd/Nd_2O_3. **B**) O 1s spectrum of electrodeposited Nd/Nd_2O_3. **C**) Survey spectrum of Nd/Nd_2O_3 deposited on copper electrode.

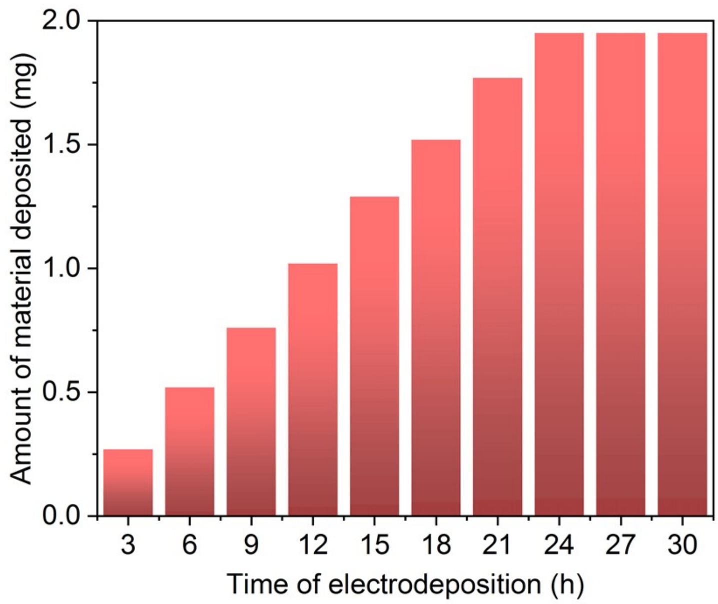

Figure S19. Amount of electrodeposited material as a function of deposition time.

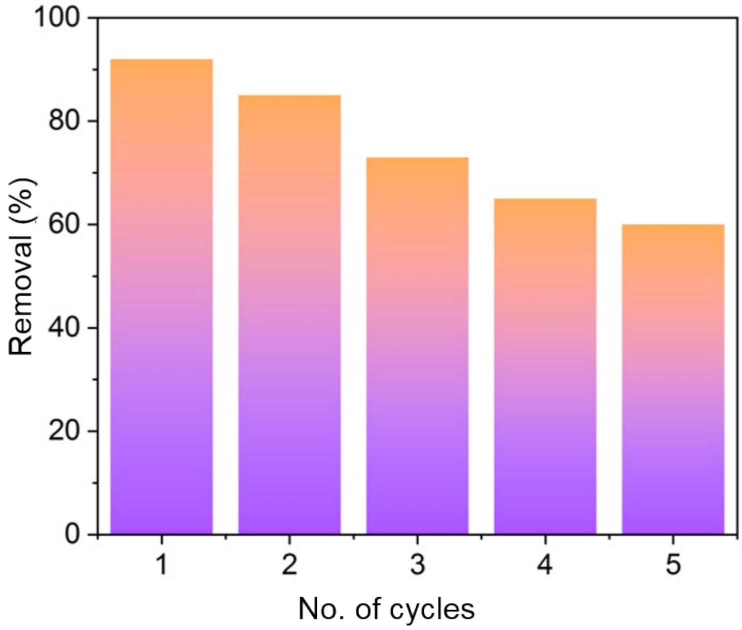

Figure S20. Reusability of CFNC for Nd^{3+} adsorption.

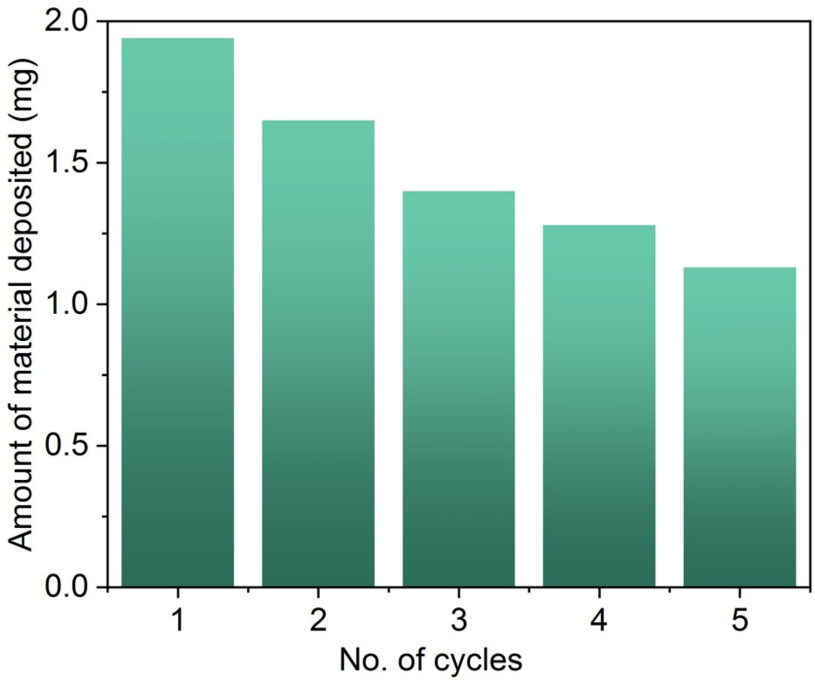

Figure S21. Amount of material electrodeposited after reusing CFNC for five successive cycles.

Categories		**Cost**
Materials	Wood pulp cellulose	$767
	Sodium chloride ($NaCl$)	$1,132
	Sodium chlorite ($NaClO_2$)	$10,800
	Sodium metaperiodate ($NaIO_4$)	$18,392
	Hydrogen peroxide (30%, H_2O_2)	$2,382
	Sodium hydroxide ($NaOH$)	$106
	Nitric acid (HNO_3, trace metal basis)	$8,483
	Ethanol	$89
Environment	Vegetation restoration	$932
	Water treatment	$268
Equipment	Apparatus required	$105
	Instrument charges	$2027
Labor	Single person	$2500
Electricity	Solar electricity	$500
Water	_	$50
Taxes	FCC	$1
	OAC	$244
	Indirect	$35
	General	$160
	ADC	$75
	Resource Tax	$1953
Total Production cost		$51,001
Total Market value	$123/Kg x 700 Kg of Nd + $50/Kg x 300 Kg of Nd_2O_3	$101,100
Benefit	Market value – production cost	$50,099

Table S1. Cost-benefit analysis for obtaining 1 ton of material by our proposed approach.