Supplementary File

Forest waste to Carbon Nanotubes: A Green Approach using NADES template for Reactive Orange 16 Dye Adsorption

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Table S1: Table for comparison of synthesis of CNTs

Reference	Carbon Source	Synthesis Technique	Synthesis Parameters	Catalyst	Disadvantages
Zhang et al. [1]	Methane	MW- assisted CVD		Nickel	• Difficulty in scaling up • Require specialized microwave reactors
Paul et al. [2]	Coconut Oil	CVD	850°C, N_2 atmosphere	Fe particles	• High energy consumption • Difficulty in process optimization
Zhu et al. [3]	Bamboo charcoal	CVD	1200-1500°C at 10°C min^{-1}, Ar atmosphere	Mineral content in char	• Variable mineral content can lead to variation in CNT quality.
Shi et al. [4]	Gumwood	Microwave induced pyrolysis	500°C, 30 min, N_2 atmosphere, 2.45 GHz multimode microwave cavity	-	• Low yield • High energy consumption
Wang et al. [5]	Rice Husk	MW-Chemical vapour deposition	2.45 GHz microwave power, 300 m Torr pressure, Ar and H_2 to generate plasma	Nickel	• Method may result in high D/G ratio.

Hamid et al. [6]	Olive oil	Pyrolysis	900°C	$NiCl_2$	• High temperature requirement. • High economic barriers
Fathy et al. [7]	Rice Straw	Conventional CVD	800°C	Ferrocene and Nickel	• Complex Pre-treatment processing. • Risk of catalyst contamination. • High temperature
Debalina et al. [8]	Sugarcane bagasse	MW pyrolysis	600 W, 500°C	Fe and Co	• Difficulty in maintaining process parameters. • Difficulty in catalyst integration.
Zhang et al. [9]	Pine nutshell	MW-Chemical vapour deposition	600°C, N_2, Power: 2kW, 60 min	Nickel	• Challenges in scaling up. • Plasma instability leads to defective product formation.
Omoriyekomwan et al. [10]	Palm kernel shell cellulose	MW pyrolysis	Power output: 2000W, Frequency: 2.45 GHz, 600°C, N_2, 60 min	-	• High energy consumption
Hildago-Oporto et al. [11]	Biochar from waste of wheat straw, oat hulls, rapeseed cake and hazelnut hulls	Microwave Irradiation	600°C, Frequency: 2.45 GHz, Power: 200 W	Ferrocene	•Low CNT quality and structural defects.
Roquia et al. [12]	*Juglans regia* (walnut) shells	Pyrolysis	700°C, 4 h, Ar gas	Ferrocene and Benzene	•Use of harmful catalysts. •Scale-up challenges.
Le et al. [13]	Eucalyptus oil	Pyrolysis	800-900°C, 30 min, N_2 gas	Ferrocene	•High temperature requirement. •Yield and purity challenges.

MW: Microwave; CVD: Chemical Vapor Deposition

Table S2: Composition of various NADES used

Sr. No.	Hydrogen Bond Acceptor	Hydrogen Bond Donor	Molar Ratio	Results
1.	Choline Chloride (ChCl)	Oxalic Acid	1 : 1	Successful
2.	ChCl	Hydroquinone	1 : 1	Unsuccessful
3.	ChCl	Glucose	4 : 1	Unsuccessful
4.	ChCl	Citric Acid	1 : 1	Unsuccessful
5.	ChCl	Lactic acid	1 : 1	Unsuccessful
6.	ChCl	Oxalic Acid	1 : 2	Unsuccessful
7.	ChCl	Oxalic Acid	1 : 3	Unsuccessful

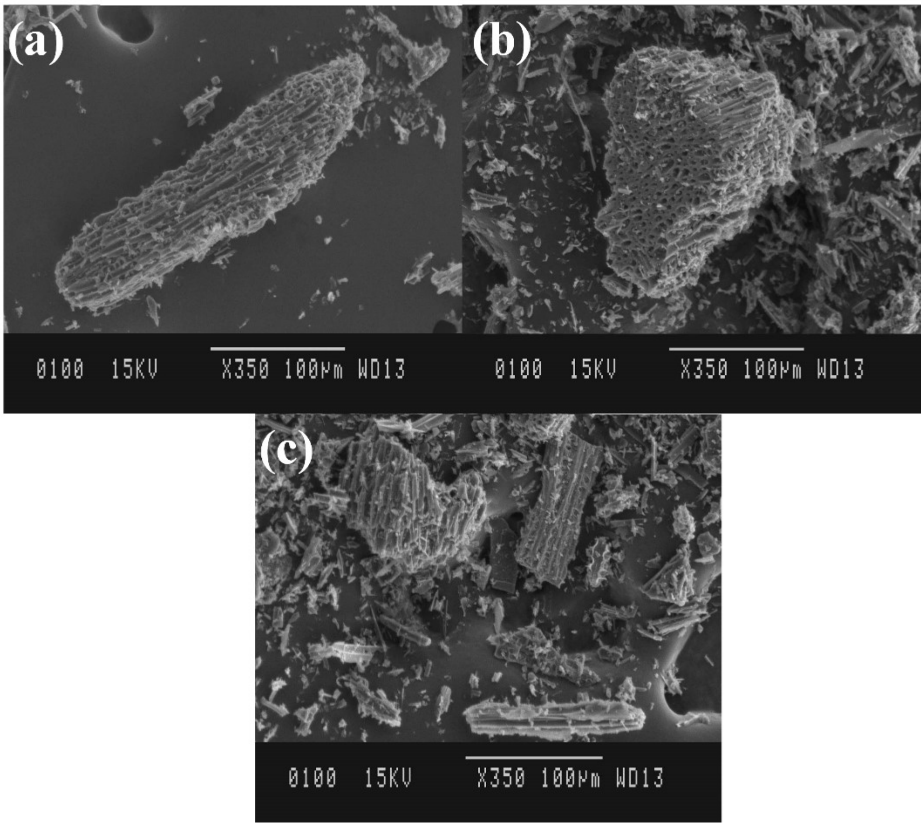

Fig. S1. SEM images of carbon materials synthesized at (a) 1 h (b) 3 h (c) 8 h

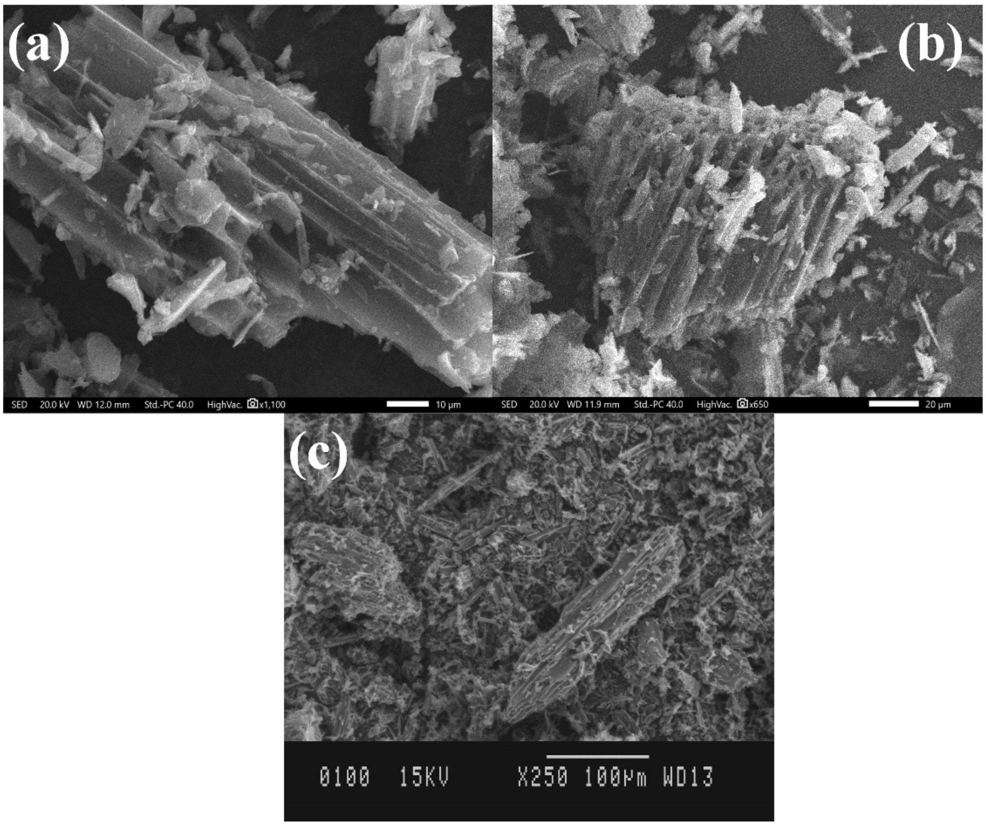

Fig. S2. SEM images of carbon materials synthesized with different molar ratios of [ChCl/Oxalic acid] NADES (a) 1 : 2 (b) 1 : 3 (c) 2 : 1

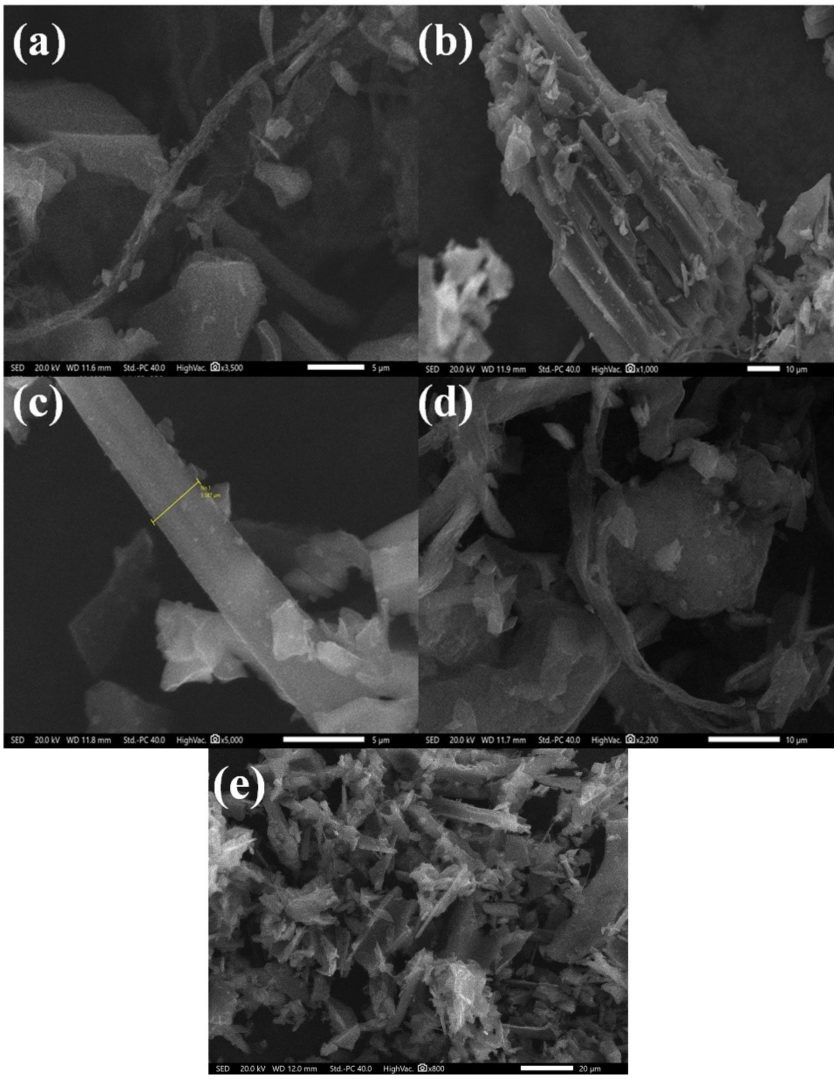

Fig. S3. SEM images of carbon materials synthesized with different NADES (a) [ChCl/Glucose] (b) [ChCl/Citric acid] (c) [ChCl/Hq] (d) [ChCl/Lactic acid] (e) Without using NADES

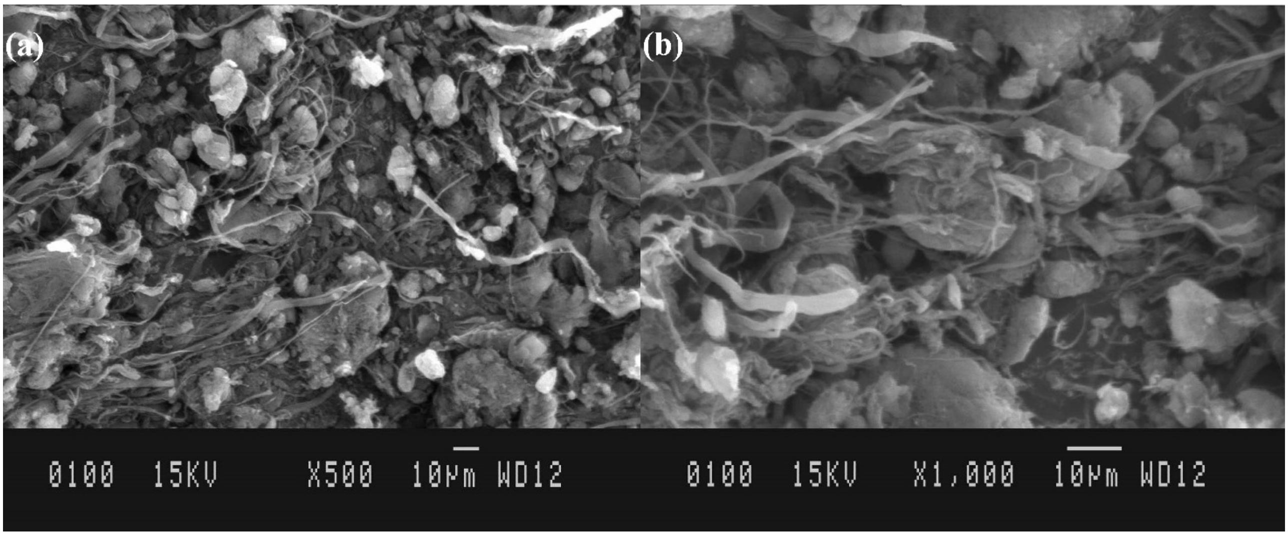

Fig. S4. SEM images of CNT synthesized using [ChCl/Oxalic acid] NADES (experiment performed in duplicate)

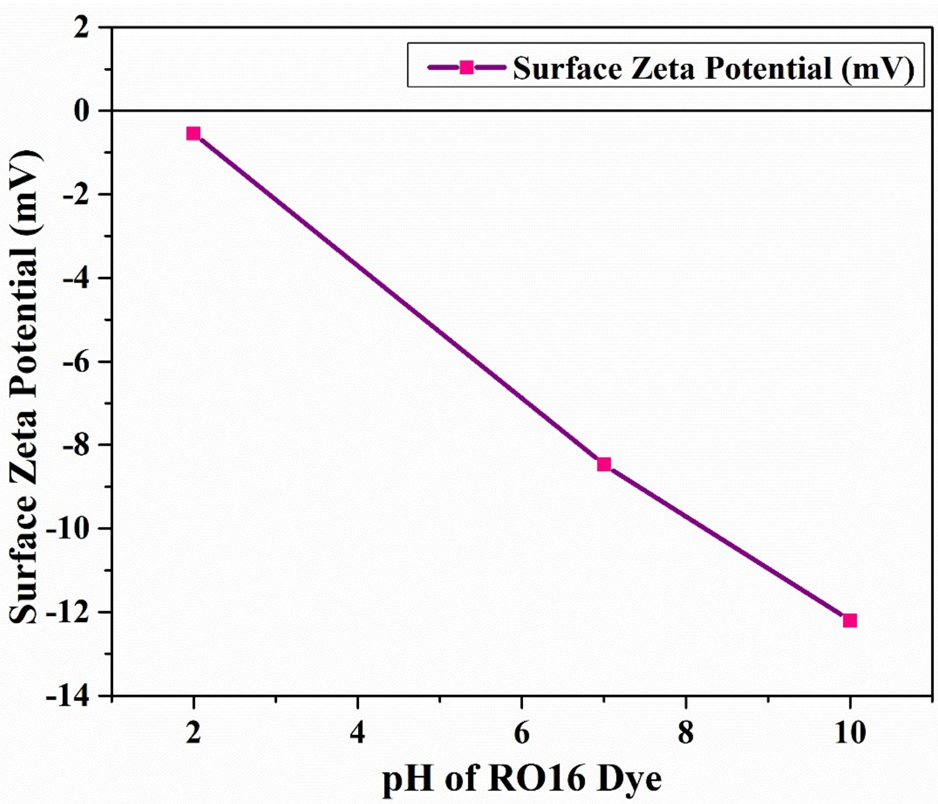

Fig. S5. Surface Zeta Potential of RO16 Dye at pH 2, 7 and 10.

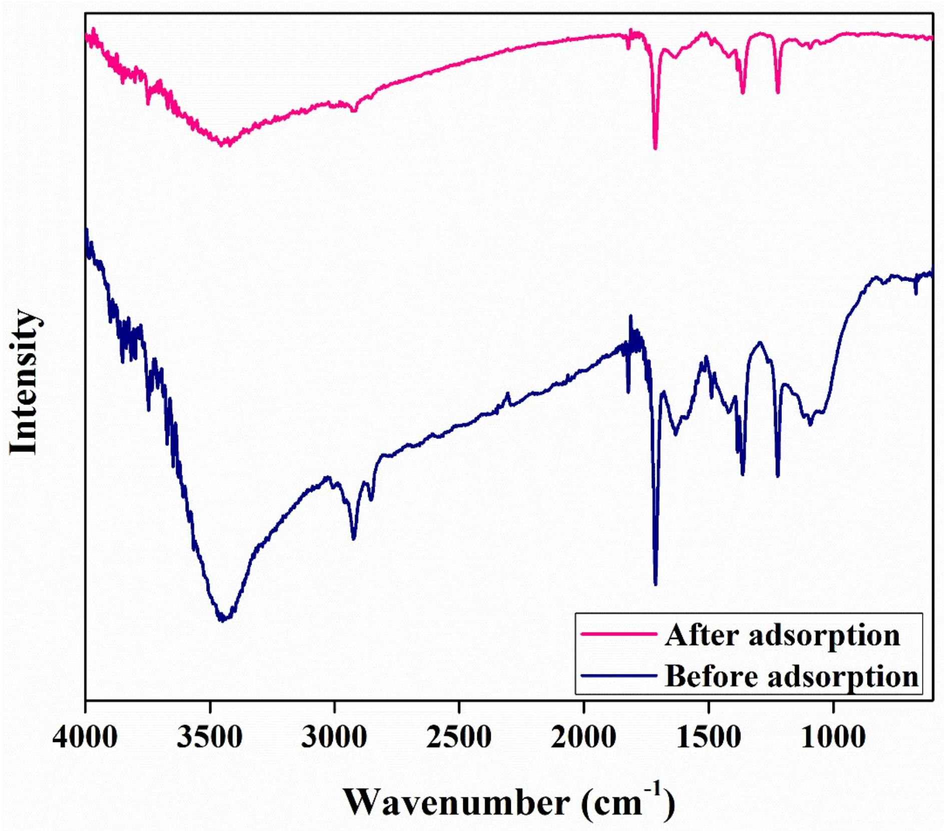

Fig. S6. FTIR of adsorbent before and after adsorption

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